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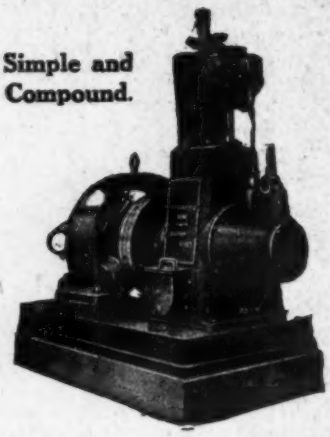

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CHINA.

UNDER the prevailing conditions there is a natural tendency for manufacturing and trading representatives to limit their attention to markets that are of immediate practical importance, where orders in plenty are waiting to be picked up. There is so much business in hand that there is no pressing need to think much about what we may describe as the remoter markets. The difficulties of dealing with what we have are sufficient to go on with, without worrying about things that are far ahead. The disposition, as we say, is not unnatural, considering the conditions. Happily, however, there are some British electrical industrial concerns which are able to rise superior to the temptations of the times, and their foresight and enterprise in many parts of the world will bring their reward in due course, when our constantly increasing productive capacity will be subject to less strenuous and exacting demands for manufactures for home consumption.

During the last six years we have been more or less deprived of trade reports from Government agents abroad. In pre-war days we quoted a good deal from those despised documents; but while we could do little export trade, reports were less necessary, and their absence did not matter much. Shortly after the Armistice was signed, we collected articles from experts in several Colonies regarding the prospects for electrical trade after the war, but even then things were so unsettled everywhere that the study could be little more than a stop-gap contribution to foreign electrical trade literature.

To-day we are being favoured with a revival of the Government reports, and though some of those so far received have been of very little value, as in the case of the German one that we recently criticised, others that are coming to hand deserve careful attention from those who want to know the trade conditions and prospects as they appear to commercial counsellors and secretaries on the spot.

One of the reports that now lie before us deals with China, a land of vast distances, much mystery, hundreds of millions of population, immense resources—really a most fascinating land for those who do not live too much in the present. The document has been prepared by Messrs. H. H. Fox, C.M.G. (commercial counsellor at Shanghai), C. A. W. Rose (commercial secretary at Peking), and H. J. Brett (commercial secretary at Hong-Kong), and it reviews the conditions and prospects of British trade with China. Consistently with our previous attitude—for we devoted a large amount of our space to the future of China in pre-war days—we incline to give prominence to this document with a view to commending it, and the country to which it relates, to the close attention of our readers who may find it a little refreshing to lift their eyes beyond Europe for a few moments.

In the year 1919 there were nearly 340,000 foreigners

resident in China; over 300,000 of these were Japanese or Russian—mainly in Manchuria and the Province of Shantung. The third in importance numerically were the British, who numbered 13,221, with 644 firms, and the Americans came next with 6,659 and 314 firms. The French (4,415), Portuguese (2,890), and Germans (1,341 with two firms) follow, and the remaining nationalities all stood at below four figures. The commercial capital, Shanghai, had a rapidly increasing foreign population, owing to the commercial and industrial expansion of the port, and partly due to a temporary influx of Russian refugees from Siberia.

For many years under nominally Republican Government, internal dissensions have produced a condition of administrative chaos, but seemingly the ordinary life of the people and the interests of trade have been less affected than might have been expected, by a condition of things bordering on anarchy, excepting in the areas of actual fighting. Financial and administrative confusion is nevertheless a very real obstacle to that great development of her natural and industrial resources for which China would seem to be ripe. While fundamental changes do not happen in so vast a territory at a very rapid rate, it is unlikely that the present state of unstable equilibrium can be maintained indefinitely.

The development of trade, and, indeed, the whole national existence of China are stated to be mainly dependent upon the rapid extension of internal communications, more especially railways. It is now many years ago since we gave particulars here of vast schemes of railway construction which leading authorities were eager to see carried out, but events have willed otherwise, and the great developments that we then hoped for at a fairly early date have not been proceeded with yet. We read, however, that within the last few years a strong movement has arisen toward the unification and standardisation of the various lines, and the technical aspects of the question have recently been studied by foreign experts engaged by the Chinese Government.

It is said that China has been suffering for a long time from the want of a strong man, and if Chang Tso-lin, "a superman among the Tuchuns," be the one whose shoulders are able to carry the mantle of Li Hung-Chang and Yuan Shih-Kai, as a writer in the *Times* of August 12th suggests, the situation may improve and movement take place in the direction of the long-desired progress. An enterprising transportation policy must involve the construction of many thousands of miles of railway and the modernisation of the service of the innumerable waterways upon which motor-boat traffic is already developing and creating a good opportunity for foreign manufacturers. Little that is creditable can be said regarding Chinese roadways, though the introduction of motor-cars is having an improving effect in this connection. Aeroplanes have their special value, but doubt is thrown upon the early use of these—at any rate, as a commercial proposition; they might be of service to enterprising foreign trade investigators or organisers on special expeditions bent.

China contributed little save labour to the European War, and her direct gains from it were not very extensive. The principal way in which she suffered was from the inability of the Allies while they were so seriously pre-occupied to render assistance in developing her trade and resources. Perhaps, in the long run, it will be seen that her greatest gain, though indirect, is from a hastening of the gradual awakening of the Chinese people to a realisation of their own backwardness, and to a conviction that the growing force of public opinion should ultimately be to the advantage of the country. Notwithstanding the still disturbed state of Europe and the economic difficulties of all countries that were long engaged in hostilities, the Allies are now freer to assist in the development of Chinese resources, but the will is necessarily subordinated to the financial situation. The nations that are first ready to render assistance have a grand opportunity awaiting them. The British share in whatever is done should be large, if we are to place any special value upon the predominance of Britishers among the "foreigners" in the numerical summary that we have given above.

So far as mining enterprises are concerned, there are important obstacles in the way of foreign participation, and in this matter progress must be slow until the mining laws are rendered more acceptable to foreign capitalists. China has, of course, innumerable industrial establishments, but we are advised in the report before us that there is little reason for British manufacturers to fear competition from these for many years to come. They are devoted mainly to the production of cheaper goods, and with the growing prosperity of the country, imported articles of a higher quality than can be supplied locally will be in increasing demand. It is considered that the industrial development of China will offer a valuable market for all kinds of machinery, and a most promising field for investment in local enterprises.

British merchants and British goods enjoy an exceptionally high reputation there, and this fact naturally renders our prospects excellent if our manufacturers are prepared to make the necessary effort to meet the demand. "By far our most serious competitors . . . are the Japanese and the Americans." America's trade with China has tripled within the last six years, and, as for Japan, well it might have been supposed that, with so vast a market so close at hand, she would be able to do so much quick trade that she would not be very anxiously concerned to compete with other manufacturing nations in the fields where the latter have been so long established, except from the standpoint of the desirability of maintaining a general interchange of trade with all parts of the world. Chinese boycotts of Japanese goods do not seem to have any serious effect upon the volume of trade.

It may be remarked that all of this information is interesting enough, but very general. We have only attempted to give a general review of the situation, in order to bring the future greatness of the Chinese market once more under the notice of British engineering and electrical firms. The British Engineers' Association did a good deal a few years ago to nurse Chinese trade, and though the war inevitably did much to interfere with the practical success of its activities, some of the spade work then done will, no doubt, produce good results. There are many centres in China where electrical works are in existence, and the number of these is increasing, and must continue to do so at an accelerated rate, if general headway now begins to be made with the development which will ensue upon the settlement of internal dissensions, assuming that strong government of the Republic will become an actual fact before long.

British electrical manufacturers who have been on the ground for many years, and a number of British electrical and other traders now there, are ready to lend a hand with the general boosting of electrical applications. The Shanghai municipal electrical undertaking affords a very fine example of a successful electrical enterprise rendering immense assistance to the development of industrial works, and its reputation must have some penetrating influence upon the Chinese mind. And what of the work of the Hong-Kong University, where Chinese students are continuously under British tuition and in the presence of British electrical engineering equipment?

These things are all part of the whole contribution of British influence in electrical affairs in China, and they should help us to achieve much when the time is ripe. But now, even now, there are substantial electrical competing organisations of other nations alert and active on the spot, and we cannot afford to rest content with what we are already doing, however busily we may be occupied.

The report before us contains a good many suggestions for the development of British trade in China. They relate to the standing of British merchant firms, to selling methods suited to the market, to trade propaganda, and many other matters, and give various hints regarding what British firms should and should not do. These, the manufacturer or trader who is sufficiently interested in the subject, will naturally want to investigate closely for himself, and to that end we refer him to the complete document [Cmd. 853—9d. net.], which is obtainable at H.M. Stationery Office in London.

Obstructionism as a Fine Art.

Few industries have given so fine a field for obstructionism as the electric supply industry. Practice makes perfect, and the history of the industry is little more than a succession of ultimate triumphs over a considered and deliberate inertia in the body itself. And this developed genius for obstruction seems, almost through sheer habit, to show itself perennially. At the present time, despite the general, one might almost say, universal welcome given to the Electricity Act of last year, and the mutual congratulations over what now it would be possible to do, this old spirit of passive resistance is again showing its head. A signal instance is the case of Bath in connection with the West of England Joint Authority. Bath authorities have no tangible objections to the proposed scheme. They confess they are merely apprehensive. Why not, therefore, they say, postpone the whole matter until all misgivings have been laid to rest. They are urging the Electricity Commissioners, therefore, to defer the delimitation of the area and other pressing matters until someone (they does not seem clear who) satisfies them that by not the remotest contingency could any harm come to Bath. No reasons have been furnished, they querulously complain, in support of the proposed boundaries of the area; no opinion can be formed, they say, as to the position of Bath consumers under the scheme, as to price or conditions of supply, and so on. But who, we ask, is to prognosticate at this juncture? What will happen depends on the sufficiency of the scheme, and this in turn depends (a point Bath apparently does not realise) upon the voluntary co-operation of the big undertakings.

It is not an *outside scheme* which Bath is asked to *accept*. The essence of the whole proposal is that Bath is asked to join with others in formulating an engineering scheme. Bath will have proportionately as much "say" as anyone else. The situation resolves itself into a logical circle. Bath will not join in until the success of the scheme can be assured. But a preliminary condition of such success is that Bath, and other similar undertakings, join in at the beginning. In a word, Bath and everyone else must all take the same share in risking eventualities. It is to be hoped that the Commissioners will not accede to the slumberous appeal, natural though it might be, for did not Swinburne sing of the city—

> "City lulled asleep by the chime of passing years,
> Sweeter far thy sleep than the radiance round thy peers."

But however much "sleep" may be a cherished possession traditionally and poetically, it is not a characteristic to be encouraged on the present occasion.

Control of the German Export Trade.

The electrical industry in Germany, as in the case of other industries in that country, is under the control of a separate foreign trade department in regard to the export trade. At the instance of the Foreign Trade Department for Electrical Engineering, a meeting was held recently at Berlin, when there were present representatives of the Chambers of Commerce, the authorities concerned, representatives of merchants and export organisations, and a number of firms who, either as merchants or manufacturers, have a special interest in the common and intelligent regulation of export questions and export prices. The object of the gathering was, by general discussion between all parties interested, to clear the air concerning the method of working and effects of the department and its control over foreign trade. Herr Brandt, manager of the department, stated that the department was established in order to adapt the trade to the changed conditions as soon as possible, and to aim at a simplification of the course of business. The reduction in the so-called social export tax of up to 10 per cent. of the invoice value, which had been asked for, had been sanctioned by the Special Committee of the Federal Board for Economic Affairs in the case of a number of electrical productions. As to the suggestions made in various quarters for the complete abolition of the control over foreign trade, the opinion of the Special Committee in question was that the time had not yet arrived for entire freedom, as stability in industry had not yet been established. The representatives of producers laid emphasis on the fact that the Council of the Central Syndicate of the Electrical Industry had again adopted a resolution in favour of the maintenance of the department in its present form. This decision was prompted by the consideration that the difference between inland and export prices should not again be allowed to be the cause of a "sale" or dumping through an impending reduction in prices. The representatives of the merchants were also in favour of the retention of control, although they urged a simplification of the regulations; and the workmen likewise supported the maintenance of the department. It was finally mentioned that the department had established a foreign information service which, with the support of makers and of exporters, would afford an opportunity for all interested parties to be informed of the situation and changes in the markets of the world.

The Swiss Electrical Industry.

The Union of Swiss Electrical Works, reporting on the situation in the present year, states that the prospects are unsatisfactory, and a recovery of the world's economy is hampered by the involved political and economic conditions in most of the late belligerent countries. In the case of many undertakings in the Swiss electrical industry, the cost of production is no longer in proportion to the profits, and if the situation does not soon change, some works will have to continue to employ their workmen without realising any return. If this position of affairs should become general, as appears likely, the industry will be confronted with a serious crisis in the near future. Under these circumstances the report states that a reduction in the prices for manufactures cannot take place at an early date; on the contrary, an increase in prices must be reckoned with owing to the increased wages and salaries simultaneously with a reduction in the working week which has been introduced.

Coming Events.

On Tuesday morning next the British Association for the Advancement of Science commences its annual meeting at Cardiff. The proceedings do not nowadays open with the great evening assembly at which a large and distinguished company of scientists—and some others—listens to the main presidential address. Members plunge right into the sectional work on Tuesday morning, and Prof. A. S. Eddington, F.R.S., reads his address as President of the Mathematical and Physical Science Section; Prof. C. F. Jenkin, C.B.E., delivers his discourse in the Engineering Section; and the numerous other sectional presidents open up before their respective meetings of specialists in economics, education, and so forth. A few papers in each Section will doubtless follow, and, after much hand-shaking and renewals of friendship in the afternoon, the privileged ones will dress, dine, and otherwise prepare for the evening meeting, when Prof. W. A. Herdman, F.R.S., Professor of Oceanography in the University of Liverpool, is to deliver the Association address. From Tuesday until the following Saturday will be occupied with the reading of papers, discussions, visits to places of interest, and evening discourses.

A week thereafter we shall turn from the scientific and the sublime to something far more prosaic and practical from the engineering point of view, for on Saturday, September 4th, the long-prepared-for Machine Tool and Engineering Exhibition will open at Olympia. It will remain a live centre for all interested in machine tool and general engineering matters, including electrical applications to tool driving, until September 25th. While it is in progress the Municipal Tramways Association will be holding its annual convention. The meetings of the Iron and Steel Institute and the Institute of Metals are also near at hand.

These gatherings and the exhibition will, no doubt, afford a good deal of interest for electrical men during what may be—save from the point of view of political possibility, and from the standpoint of the general electrical trade, which is very much alive—a somewhat unexciting vacation month.

METER WORK IN AN ELECTRICITY SUPPLY SYSTEM.

By C. SYLVESTER, A.M.I.E.E., A.M.I.Mech.E.

Meter work in a supply system is, in the majority of cases, looked upon as something of minor importance, and it is by no means unusual to see it carried on in some out-of-the-way corner of the power-house, in a position that is not suitable by any means, and where the ill-effects of damp and dust are not considered in the slightest degree.

When one considers the function of meters in a supply system, it seems strange that efficient means of testing and checking them are thus ignored. The meter calculates the income of the company. If a meter is running slow, it causes a direct loss of income. If it runs too fast, it is robbing the consumer, and he will very quickly become dissatisfied.

I have in my mind's eye several meter "test rooms" of some large power companies. The most prominent, perhaps, is one in Scotland, where I was engaged some time ago erecting some power units. The room is situated in one corner of the battery room. It is quite a good battery room, but a very poor test room. The test bench consists of a wooden box, turned upside down, and on the front of this box a bank of lamps is fastened—quite a convenient arrangement.

One end of the box is broken, but a half-brick serves the purpose of levelling it up. You see, even here, it is realised that the meter must be comparatively level if it is to be read anything like correctly. A rheostat is fixed on the wall in a convenient position for handling, but the resistance is an electrical curiosity. It is a mixture of German silver, "eureka," and wrought-iron wire, merely twisted together as necessary to allow a certain amount of current to pass, according to the test being carried out. The tester knows which ends to twist together to obtain a certain joint resistance.

Three ordinary tumbler switches are used, instead of neat rheostat contacts. If the tester forgets to switch one off before he puts the other one on, the fuses blow. When a test is being carried out, the tester has to stand with his legs almost crossed between two carboys of acid. Can it be wondered at that an efficient test cannot be carried out under such conditions?

It is not necessary for me to go into details concerning any of the other test rooms similar to the one I have described above. They do exist, and the engineers in charge of them are ashamed of them. In some cases it cannot be helped, because money cannot be obtained to build a special test room with first-class facilities for systematic inspection, control and repair of the meters. In many cases, however, temporary test rooms can be made with little or no expense. He is a poor engineer who cannot obtain a certain amount of material and labour for such an important purpose.

I have seen many up-to-date test rooms which contain everything that can be desired for the correct and efficient testing of electricity meters. Many of them, as a matter of fact, contain much more equipment than is really necessary for such a purpose. One test room I know of boasts of a Duddell oscillograph. What on earth it is there for I do not know, unless it is to loan to electrical contractors who may wish to determine the shape of their alternating current or electromotive force wave. However, it is an ornament to the test room, and even as such it is appreciated.

It is not my object in this article to go into details of meter testing. It is rather my desire to discourage slipshod methods of testing, and to encourage the erection of even passable test rooms. I hope with these few words to arouse a keener interest, from an efficiency point of view, in some of the meter departments which are open to considerable improvement.

To build a test room, even in these days, does not require a large amount of money. It must be built of brick, at least to a height of about 5 ft., to allow for the rigid fixing of instruments and rheostats. Above 5 ft. in height the walls and roof may cheaply be continued with wood, covered with "Uralite" or other fire-proof material. If the brickwork and "Uralite" be distempered on the inside, quite a nice job will be made of it. The test room should be erected away from the main building of the power house in order to eliminate the vibration from the steam turbines, especially if they happen to be running "on atmosphere."

The fitting-up of the test room and the location of the necessary instruments should receive very careful consideration; it is only by experience and judgment that the correct position of the instruments may be chosen. Each instrument must be considered not only from a light and convenience point of view, but with regard to the surrounding instruments, and the machines it will be necessary to erect in the test room for testing purposes. In other words, each instrument should be fitted in such a position that it will not be affected by stray magnetic fields. The rheostats used in the test-room should be wound with resistance wire of sufficient cross-sectional area to enable the maximum amount of current to pass through it without causing an increased temperature rise in its vicinity. The temperature rise of carelessly chosen resistances will be responsible for errors in calibrating which, if not carefully checked, will cause the "units" usually put down to "mains losses" to increase considerably. As it is usual for the instruments to be placed near the rheostat, to facilitate handling when under test, the resistance wire

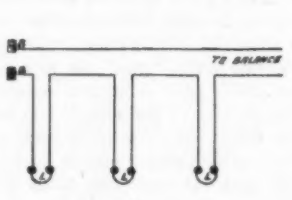

Fig. 1.

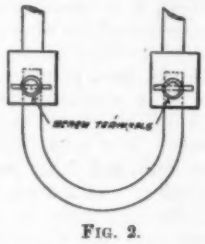

Fig. 2.

should be non-inductively wound upon its insulator. Resistance units consisting of wire wound on an enamelled steel tube should be avoided as far as is possible, even though the wire is wound upon the tube non-inductively. A set of storage cells should form part of the test-room equipment, and is an essential item if a photometer is used. The position for the erection of these cells is outside the test room. If they are placed inside, trouble will commence through the effect of the corrosive fumes upon the instruments.

It is the practice in several test rooms of which I know, to have a wooden bench fitted round a portion of the walls. This bench is covered with green baize, and the instruments are placed upon this during the test. This is not an ideal system by any means. It would appear that a much better method is to let pieces of angle iron into the wall, and to place slate slabs upon them. There should be no difficulty in fixing these, because a wooden strut will hold them in a levelled-up position until the cement is set. Failing the obtaining of angle iron, the next best method would be to have brick pillars built up to the required height. However, no matter what method is adopted, it is necessary that the test bench should be perfectly rigid, and not susceptible to vibration.

The equipment of a test room should include instruments for testing, in addition to the power-house instruments, meters for both alternating and direct currents.

In a direct-current supply system, a small motor-generator can be used to produce alternating current at the generator end. The direct-current leads into and around the test room to the various rheostats and points of use, should be carried in pairs upon insulators. That is, when one wire is run to a testing point in one direction, the return wire should return upon the same insulator, and as close to the first wire as possible. This will prevent stray fields which would be set up if the wires were run quite indiscriminately.

It will sometimes be necessary to test meters of very large capacity. For this purpose it will hardly be convenient to run insulated copper cables round the test room. Difficulties of obtaining a good contact upon these cables will be great. An excellent method appears to me to be that illustrated in fig. 1. Here the large main cables are conducted to two terminal blocks, B B. From these blocks, round the test room to the point where it is necessary to control the heavy currents, usually carried out with the aid of a Kelvin balance, bare copper rods are run on special insulators. A tapping may be made from these rods to the meter to be tested through copper links, L. Three of these links would be sufficient over one bench, and the link nearest to the meter to be tested would be disconnected, and heavy cables from the meter inserted in its place. Fig. 2 illustrates the construction of the link and the blocks connected to it.

Heavy currents may be obtained from a motor-generator. The motor would operate from the power supply mains, and would be direct-coupled to a generator of large current capacity, with a range of four to eight volts. It may be shunt-wound, with a shunt rheostat of large current capacity in series with the field windings. Circuit-breakers may not be fitted, since the insertion of the whole of the resistance in the shunt field should reduce the generator voltage to zero. The instruments used in connection with this generator would be a low-reading voltmeter and ammeter. The ammeter would, of course, be of the shunt type, since a series ammeter would mean a considerable distortion of the main cables, and the loops would be liable to set up stray fields.

The method of regulating the current through the Kelvin balance is by means of large carbon blocks, which should be able to carry the whole of the current without overheating. This is a point which should be very carefully watched in a test room. I have known these blocks, when they have been removed from their troughs for cleaning purposes, to be handled carelessly. The result has been that they have been chipped, and their surfaces have become uneven. When it has been necessary to use the instrument, considerable arcing has taken place on the faces of the blocks. This makes matters much worse, because, in subsequent tests, as the carbons are squeezed together, a large amount of current passes through a much more limited contact surface. The result is that the carbon blocks, getting red hot, are entirely destroyed.

Even the poorest test room would not be complete without a potentiometer. It only needs a few meters to be brought in for test that are all reading too fast, or too slow, as the case may be, for some doubt to be thrown upon the accuracy of the standard instruments. When this happens, it is quite a relief to be able to assure oneself, with the aid of the potentiometer, that the standard instruments are not erratic. The potentiometer will measure current, pressure, and resistance very accurately, hence it is an asset to any test room.

The standard instruments desirable in a test room may be classified as follows:—(1) Ammeter; (2) voltmeter; (3) wattmeter; (4) reflecting galvanometer, for use with Wheatstone bridge or testing test; (5) chronometer.

A considerable amount of importance is attached to the last item from the fact that it is necessary to create a standard of time. When one is testing a meter with an ordinary stop-watch, errors are liable to occur, especially if the revolutions of the meter disk are very high. A chronometer will effectively check any chronometer stop-watch, which is liable to fluctuation, and which certainly has a starting and stopping error.

It will be necessary to have step-up transformers in the test room. These may be no larger than the ordinary potential transformers used for operating the instruments in any A.C. generating system. Their function will be to test the insulation resistance of instruments and apparatus after repair, or after being received from the makers.

To test watt-hour meters, the most convenient instrument is the Drysdale double wattmeter. This will test meters for either alternating or direct current. It will also be necessary to include a frequency meter in the instrument equipment.

It is useless to have a test room fitted with up-to-date instruments for meter testing, if errors are likely to occur through a lack of facilities for inspection. To my mind, the best aid to inspection is a pea lamp, mounted upon a small ebonite rod about 5 in. long. This will enable it to be placed inside any portion of the meter, so that the moving portions can be easily examined. The voltage of this lamp should not be more than 8 volts. Two wires can be led from storage battery tappings, to obtain the correct voltage, round the walls of the test room. A few miniature plug sockets fitted at various suitable points will make electrical contact for this lamp quite easy.

For testing the torque of the moving element of a motor meter, it will be necessary to have a torque balance. This instrument is very simple, merely consisting of a stationary and weighing elements. The former is a metal cylinder mounted upon a special base. The latter, which is really the balance, consists of a horizontal arm carrying a standard weight, and a vertical arm. There are three small loops in the upper half of the vertical arm, and the lower half of the arm extends through the cylinder and terminates through a slot in the side. This end of the arm is fitted with a small index or pointer which moves up or down in the slot. The whole moving system of the balance is suspended on pivots and bearings to minimise friction as far as possible. The balance is connected, by means of a wire link, to a lever which has four small loops similar to those in the vertical arm of the balance. This lever is attached to the meter shaft by a friction clamping sleeve. There are two weights usually used with this instrument, these being 1 gram and ¼ gram in value respectively.

The person who is to be in charge of the test room should be very carefully selected. He should not only be clever at his work, and know exactly what he is doing, but he should be conscientious and trustworthy in every way. There should be no "half-and-half" methods about his system of testing. He must be accurate and realise that the efficiency of the entire plant, or at least the calculations for efficiency, depend upon him. Again, he should be a person who will take a considerable interest in his equipment. He must not encourage anyone in his test room who has no right to be there. He must frequently examine his instruments and plant in order that defects may be located immediately they occur.

He should see that he has a complete set of tools necessary for his work. He should have screwdrivers, small ones bent to different angles, which will easily tighten up a screw without having to tap the screwdriver handle with a pair of pliers—a procedure which will do a meter a considerable amount of harm. Spanners should be very thin and light, and bent to suitable shapes to reach any nut in the meter. For making calculations, there is nothing better than the slide rule.

It is absolutely essential, for the successful working of any power scheme, for the tester and the mains superintendent to work hand in hand with each other. There should be no friction between them. If the mains supervisor desires a meter to be tested on site, then the tester should do his duty without raising objections or questioning why the meter cannot be brought into the test room. Where the tester and the mains department have not worked in harmony, the result has been that something has been neglected.

Electric "Boilers" in Sweden.—The paper mill and sulphite factory at Vargo, Sweden, which were destroyed by fire in 1918, have been rebuilt and again set in operation. Owing to the difficulty experienced in obtaining coal the directors of the Vargo company in connection with the work of reconstruction decided to adopt electricity throughout, including the steam plant, and the works now consume no coal, whereas 20,000 tons per annum would be needed under former conditions. The boiler house contains seven "electric" boilers, each of 3,000 H.P., and the current enters the boilers at a pressure of 10,000 volts without having to be transformed down. Each of the boilers is provided with three electrodes, and the coupling arrangements are such that steam generation can be regulated within 5 per cent. It is stated that full steam pressure can be raised in from five to ten minutes after switching on the current, and considerable economy in attendance is obtained, as compared with coal firing. A steam accumulator has also been erected in order to ensure an even consumption of and economy in steam. The installation is the first of its kind in Sweden.

HARMONICS TROUBLE AND NEUTRAL EARTHING: GENERAL CONSIDERATIONS.

By L. C. GRANT.

An analysis of the wave-form of any alternator will usually disclose the presence of certain irregularities, or ripples. The most prominent of these ripples is that due to the presence of the third harmonic which may be superimposed on the fundamental wave in several ways. In general, the third harmonic may be classified as being in phase with, in opposition to, or out of phase with the fundamental wave.

A little familiarity with oscillograms enables the relative position of fundamental and harmonic waves to be readily determined at a glance. Or, the harmonic may be separated graphically by superimposing the generator wave form (if known) or a sine wave, upon the power wave.

It is difficult to eliminate the third harmonic entirely in a commercial machine, and owing to its extreme undesirability steps are usually taken to render it innocuous. The simplest way, and at the same time the most common solution with a three-phase machine, is to couple up the phases in star.

The power wave form of a generator is necessarily symmetrical about the time base, that is, the negative half wave is exactly the same as the positive half. From this it follows that no even harmonics are to be found in the wave, otherwise it would be distorted. Were it otherwise, and even harmonics possible, the harmonic wave would alternately be in phase with and in opposition to the power wave at each half-cycle of the fundamental.

In a three-phase generator the harmonic wave occupies the same position relative to the power wave in each phase. As the fundamental phase voltages are displaced by 120 deg. per phase, the harmonic is displaced by a like amount, which brings the harmonic waves in each phase into such a position that they cancel one another out, and, therefore, between the terminals of a three-phase star connected generator, the third harmonic cannot exist. This provides an easy means of removing the third harmonic from the line.

On a three-phase supply system, it is now generally recognised to be advantageous to earth the neutral point, as by so doing the potential to earth from any phase terminal is limited to the phase voltage alone. Otherwise any phase would become liable to be subject to the full terminal pressure—which is $\sqrt{3}$ times the phase pressure—to earth. Under certain circumstances an even higher pressure might exist.

Earthing of the neutral point is also necessary for the working of several types of protective gear.

So long as a generator is operating alone on a feeder or distribution system, the neutral point can be earthed in any manner thought to be desirable, but as usually happens, several generators are paralleled up to the same set of busbars. Should the neutral points be earthed under such circumstances the separate phases will be paralleled through the neutral point and earth connection. This will cause the third harmonic again to appear between each phase and the neutral terminal as the cancelling-out action cannot then take place. Moreover, the three phases will each contribute to the harmonic current, and for the triple-frequency current, the three phases of each generator will be in parallel. The result is that a current circulates between the generators from the point at which they are paralleled, and through the earth bar or earth connection. This current may very easily reach considerable proportions, and some means of limiting its value are usually adopted.

The current-limiting device employed depends upon the characteristics of the generators and upon the allowable fault current. If a number of similar generators are operated in parallel it is often quite feasible to earth all the neutrals together and direct to earth without any intervening resistance or other device. Even then, except under ideal conditions of operation, cross currents are liable to be exchanged.

The general plan in such cases is to earth one neutral only, or at the most two, as a measure of safety.

Earthing direct carries with it the further disadvantage that the earthed generator has to bear all the trouble on a fault at any point on the mains to earth. Under such circumstances, it is liable to suffer badly.

For this reason, it is considered advisable to earth through a limiting resistance and so keep the fault current down to a finite figure. Such resistances can be inserted in the generator neutral lead, or else between the earth bar and the earth plate. The advantage of the latter arrangement is that only one resistance is necessary, but with such a scheme there are corresponding operating disadvantages which are eliminated by the use of a separate resistance for each machine. For instance, with one resistance it is unsafe to parallel two neutrals when changing over generators. It is equally bad to attempt to operate with two neutrals earthed at the same time, as they will be directly connected together, and no limitation is imposed upon harmonic currents between machines. With only one neutral earthed, there is the danger of failure of that particular machine, which would cause the system to be left entirely without an earth connection.

On the whole, the soundest scheme is to use separate resistances with oil switches for each generator.

Resistances are in some cases replaced by single-phase reactance coils in the neutral lead.

There are certain disadvantages attendant upon the use of reactance in such a position, owing to the relatively high impedance imposed upon high-frequency currents, such as harmonics and surges. Under these circumstances, reactance may easily be worse than useless.

In fact, it is preferable to rely upon the reactance of the generator windings alone, and so dispense with external reactance. Owing to the relatively high reactance of a modern generator, this scheme is quite feasible in many cases.

The foregoing is, of course, only applicable to star-wound generators, but for delta-connected machines or a mixed collection of star and delta windings, the case is very different.

When delta-connected machines are in use, an artificial neutral point must be created. One way of doing this is to use an auto-transformer, but the soundest scheme is to use an interconnected reactance. A neutral compensator or choker wound on the interconnected star style gives the best results, and this is connected right across the busbars. Two can be used if thought desirable. Interconnection and splitting of the phases in this manner offers a high three-phase impedance to the magnetising current, which is thus kept very small. The single-phase impedance is very low, and on a fault this is what has to be chiefly considered; with interconnected star coupling, the single-phase impedance is practically negligible. In order to limit the fault current, a resistance becomes necessary, and is desirable for this function at any time. The resistance is connected in series with the choker neutral point and the earth connection. Copperwork between the phase terminals and the busbars and between the neutral and earth should be heavy, as under fault conditions the compensator becomes virtually a continuation of the busbars.

An oil switch can be included in the circuit between the compensator and the busbars; the non-automatic type should be used, being correct in principle. Should the compensator be coupled up without any switch, it is advisable to use a specially robust construction having heavily insulated and braced windings as the factor of

safety should be as near as possible to that of the bus-bars themselves.

In some cases, a transmission system is fed at an extra-high-pressure through transformers having their primaries connected directly across the generator terminals; the transformers and generators being run as units on their low pressure side and not being electrically interconnected. A transmission system fault under such circumstances will not affect the generators, so that all the neutrals can be earthed direct with perfect safety, even though the transformers be all in parallel on their high-pressure windings. It is clear that in this case the generator phase windings are not paralleled up so that the third harmonic cannot pass.

Should it be desirable to establish and earth the neutral point of the transmission system—which is usually the case—the interconnected reactance method can well be adopted. The insertion of resistance in the neutral connection is here again desirable, and necessary, if control is to be effected over the fault current. In the somewhat rare event of the power transformers having starred secondary windings, the transformer neutral can be earthed through a resistance as with the generators. With delta-connected transformers, arrangements could be made for bringing out the neutral point on one or more phases and earthing this, but is not a desirable practice.

To again take up the question of generating plant, it will be clear that the earthed machine or machines have to take the full fault current. On this account, they are likely to get some very severe treatment, and it is a good plan to leave work of this sort to the oldest plant available which can the most easily be spared in case of the machine giving out under the treatment.

The fault current, assuming a dead earth, will be limited externally by the resistance in the neutral connection, and the actual ohmic value of the resistance depends upon the operating conditions to be fulfilled.

Sufficient current must be passed to operate the protective gear, and, so far as feeders running separately are concerned, this is a straightforward enough matter. Generating plant is another matter altogether, as is also a large distribution system.

With feeder protective gear of the Merz-Price class, the resistance can be quite high, with a corresponding lessening of the strain on the plant and cables. Overload and leakage protection necessitate a larger setting, normally up to 300 per cent. and 50 per cent. of the full-load current respectively, per feeder.

In the case of a completely interconnected distribution system, employing overload and leakage gear, the resistance must be of large current-carrying capacity and low resistance. Anything up to perhaps ten times full-load current is possible on a fault, and must be dealt with. At the least, the operation of the protective gear must be assured, and a small margin will not assure this. Therefore, quite a bulky resistance will be required, which is a comparatively expensive item.

Metallic resistances are normally of the grid type, and rated to carry full current for two minutes. In coupling these resistances, careful setting and insulation is necessary. The insulation should be such that it will stand the tests, in the same way as that of the generator windings and switchgear.

The Brazil carbon powder resistance has peculiar advantages for work of this nature, as it has a negative temperature coefficient. The resistance is built up of units having carbon powder laid out in grooves, and can thus be considered as practically indestructible. It can be operated at a red heat. Should the fault current develop gradually and be sustained for some time, the resistance of the carbon powder will fall as it heats up, thus allowing the fault current to rise to tripping point. Of course, this feature is only exercisable within limits. With certain types of protective gear this gradual rise in current is something of an advantage.

When reactance is used in the earth connection the coils can be of several types. The coreless iron type does not require special housing, but is expensive to buy. The air-core concrete type of reactance is cheap in first cost, and is very strong. It needs to be specially housed, on account of the live metal exposed, which adds to the expense to a considerable extent. It is, however, likely to be cheaper than the iron type when a station is being newly laid out, and provision made for everything at the outset.

Another type of concrete reactance has paper insulated, lead-covered coils. It can be said to occupy a midway position as regards cost between the iron and the air-core bare conductor types, and needs no special housing. The convolutions are usually embedded compietely in the concrete and dividing boxes or sealing ends used to couple it into circuit. One much used and very effective way to house a reactance of this description is to bury it in the ground, where it can be almost forgotten.

SAVING THE COST.

Illustrated by an Inexpensive Method of Fixing Accessories to Walls of Buildings.

By J. T. TOWLSON.

In the following article it is by no means the writer's wish to give offence to anyone, but only to state a fact, and to offer something sincerely believed to have some little value. If, however, while stating the fact, and adversely criticising the wasteful methods frequently adopted when it is required to firmly fix a frame, a switch, or any similarly formed piece of mechanical equipment, the orthodox methods are spoken ill of, it can be no fault of the writer if such criticism touches some susceptibilities. We must

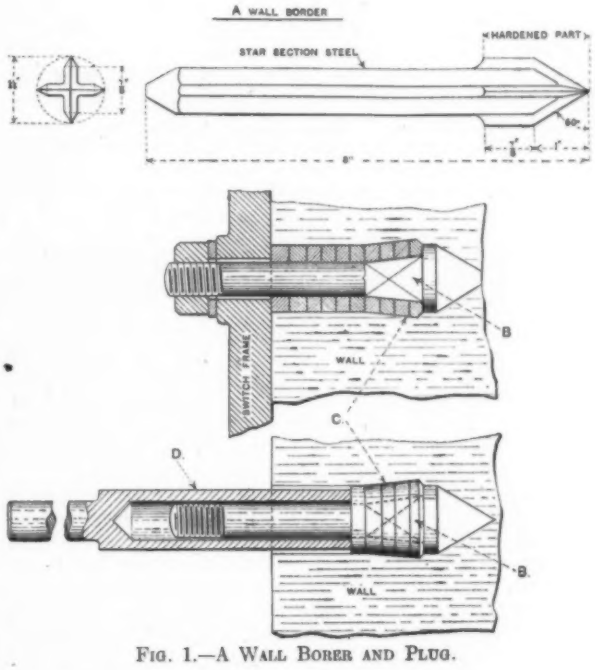

Fig. 1.—A Wall Borer and Plug.

forsake the time-wasting ways, traditional and revered though they be, if a better way comes along. It is reasonably believed that such is quite acceptable. I have worked with men for many years who hang frames on walls, and the way they do it, the time it takes, and the cost incurred in respect of such a simple piece of work, is, frequently, enough to make angels weep. I have tried, with only a little success, to get a better way adopted; the better way has been passed as good, acknowledged to be a distinct improvement, and they, the men who hang things on walls,

have gone on in just their own sweet way—"As it was in the beginning," &c. I happen to be attached to a large electrical concern in London, and, of course, we hang a lot of things on walls; besides pictures.

To hang these things, we do not call the mason—as we use no cement, nor mortar—nor do we use the mason's lump hammer and lump of steel, wherewith to cut holes in the walls. We simply do better without these, as the wireman or the switch erector can do all the fixing necessary without the mason's help. The old way has had its day.

The plan to be proposed—of which the writer is, it is believed, the originator—is really good. We, in Silvertown, have found it so. What is the traditional way by which preparation is made to hang frames, &c., on walls of buildings? It is this way:—The wireman runs his leads to the switch position; and, desirous that the switch-frame shall be fixed ere he runs his leads beyond it, he marks the holes for the frame on the wall by means of a wood template. He sends for the mason, and stands by and *waits* until he comes. He *waits* a long while sometimes, just by way of habit, and not with evil intent.

The mason arrives, with his mate (two men), and while the mason with his lump hammer and his stump of a chisel is hacking the holes in the wall, his mate may, or may not, be mixing up a bit of cement. When the holes have been chopped out and the walls sufficiently disintegrated, the carpenter is called in to block the holes with wood—yet sometimes the conditions are slightly improved—for the wireman sometimes does this, though he must not let the carpenter see him do it. Then, when the wood is grouted in the wall, it must, perforce, have time to set ere the switch is hung. So it is a case of "Leave it till the morning," and this is done. When the cement is set, the electrical man (or the carpenter) bores holes in the wood, and the wireman hangs the frame and screws in the square-head coach-screws. A day's work for a little job.

That is the case fairly stated, and it is believed that the time has come for these things to be done in a better manner.

The "Silvertown" plan is this (see sketches on page 231):—

The holes are *cut* cleanly by means of a four-point or four-edged chisel A, made from Messrs. Beardshaw's star-section conqueror steel. After each blow with a hammer, the chisel is turned 45°, just as is an Ingersoll rock-drill when used for tunnel boring.

The bolt B has a rough flat head and a square neck, and is tapered larger towards the head. The bolt is shown to the hole in the wall.

Lead washers, C, sawn from common lead pipe, are driven over the bolt shank or neck, and hard into the hole, by means of the hollow drift D. The hole is filled *hard* with these washers, quite to the wall face as shown, and as they are driven tightly home, over the enlarging neck of the bolt, they push their way, by expansion, into the brickwork, as shown. The square neck prevents the bolt turning. It is altogether a firm and permanent fixing. There is nothing now to do but to hang the switch and to tighten up the nuts. The bolts cannot draw out, and they cannot turn. I have hung a half a ton on one ½-in. bolt, and that was just a year ago. It is there in position now, and as firmly fixed as ever it was.

Let the two methods be compared. It is "minutes *versus* hours" and "coppers *versus* pounds."

Gas-Filled Lamps.—We understand that the two new sizes of low-wattage Royal Ediswan gas-filled lamps—100/130 volts 40 watts; 200/240 volts 60 watts—recently introduced, are already making great headway on the market. The Edison Swan Electric Co., Ltd., has made very considerable extensions to its Ponder's End Works, especially for the manufacture of these lamps, and with improved methods of manufacture now in operation, large quantities are becoming available for quick delivery.

A LOW-PRESSURE LARGE-CURRENT D.C. GENERATOR.

On the occasion of the recent annual visit of inspection to the National Physical Laboratory, at Teddington, a special motor-generator set that has recently been installed in the Electrotechnics Department, was seen in operation. Although the battery, having an output of something like 5,000 amperes, that has up to the present been used for the supply of heavy currents for testing purposes, has had its positive plates renewed and subsequent systematic tests made of its capacity, it has been found inadequate for the purposes for which it was intended.

Messrs. Crompton & Co., Ltd., were, therefore, commissioned to construct the machine referred to above for the purpose of facilitating the research dealing with buried cables, which investigation was delayed pending the delivery of the machine, and also for supplementing the existing sources of supply of heavy current for experimental and testing purposes generally. By the use of the new machine, in conjunction with the battery, the department will now have available low-pressure D.C. current up to very nearly 10,000 amperes.

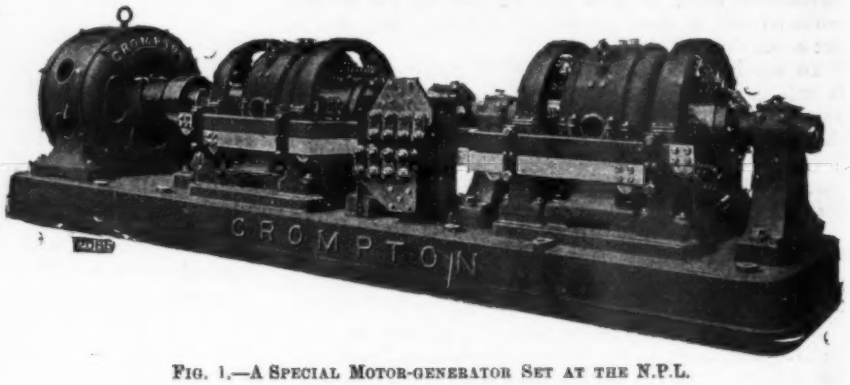

Fig. 1.—A Special Motor-generator Set at the N.P.L.

While minor difficulties have prevented full use being made of the new set, many of the important points, and in particular that relating to steadiness of current, have been fully satisfied. With a quite steady source of supply applied to the motor, the current drawn from the generators—*i.e.*, 5,000 amperes at 6 volts—does not vary by more than plus or minus 0·5 per cent. at full load.

The motor-generator set, as will be seen from the accompanying illustration, fig. 1, consists of a three-phase, slip-ring, induction motor driving two generators, each of which is provided with two commutators. The three machines are direct coupled on one bedplate, the shaft being supported on four bearings. The generators are designed to give a normal continuous output of 1,250 amperes from each commutator at a pressure of six volts. Arrangements are made to enable the four commutators to be connected in series, when an output of 1,250 amperes at a pressure of 24 volts would be obtainable. Alternatively, if the commutators are connected in parallel, the output would be 5,000 amperes at a pressure of six volts.

The speed at which the set runs is approximately 485 R.P.M., the driving motor being wound for a 50-cycle, 3,000-volt supply.

The illustration shows at the side of the machine the bus-bars, by means of which the outer commutators of the generators are connected to the link board. Similar connections, which do not appear in the illustration, are provided to connect the inner commutators to the board. It is by means of the links shown that the commutators can, as explained above, be connected in series or parallel to suit particular requirements.

In conclusion, we are indebted to Messrs. Cromptons for the illustration and the essential details of the set, and to Sir J. E. Petavel, F.R.S., director of the laboratory, for allowing their publication.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Porcelain Insulated Grills.

One of the latest improvements in grills for toasting, boiling, and frying, comes from Canada. The innovation lies in the fact that the mica insulation has been replaced by porcelain, which is claimed to give much longer life to the appliance. The 8-in. grills are made with four heats to consume 165, 300, 350, or 650 watts, or with a single heat of 650 watts, they are of sturdy construction of sheet steel and heavily nickel plated. To meet the increasing demand for aluminium cooking utensils, the pans, figs. 1 and 2, are made of heavy aluminium and well polished. A new design of toaster has a heavy cast-iron base and pressed-steel sides and top, all heavily nickel plated and beautifully polished; 600 watts capacity ensures red heat which toasts quickly. The very best resistance wire is used throughout by the makers, the Superior Electrics, Ltd., of Canada, who also make special tailors' irons, fig. 3, from 10 to 22 lb. in weight with nickel finish and a substantial cast-iron ventilated stand. Mr. C. F. Barton, 1, Regent Street, London, S.W. 1, is introducing these products in the British market.

Figs. 1 and 2.—Porcelain Insulated Grills.

Fig. 3.—Tailor's Iron.

A G.E.C. Field Control Pillar.

The field control pillar shown in fig. 4 is constructed by the General Electric Co., Ltd., of 67, Queen Victoria Street, E.C.4. It is fitted with concentric handwheels for adjustment, and with a field switch, ammeter, and voltmeter.

Fig. 4.—G.E.C. Field Control Pillar.

A Small Lighting and Power Plant.

We have recently received particulars of the "Matthews" fully-automatic lighting plant, the sole British agents for which are The Electrical Engineering & Equipment Co., Ltd., Bank Buildings, 109-111, New Oxford Street, W.C. 1. The set illustrated in fig. 5 is suitable for supplying lighting and power to a large farmhouse, hospital, country estate, or even a small village. The engine is a 20-h.p., 4-cylinder, 4-cycle overhead valve type, with cylinders cast in block. The h.t. ignition is obtained by means of a "Dixie" magneto driven off the pump shaft. The generator is of 5 kw. capacity working at 110 volts. The set is accompanied by a 110-volt, 126 amp.-hour "Willard" battery.

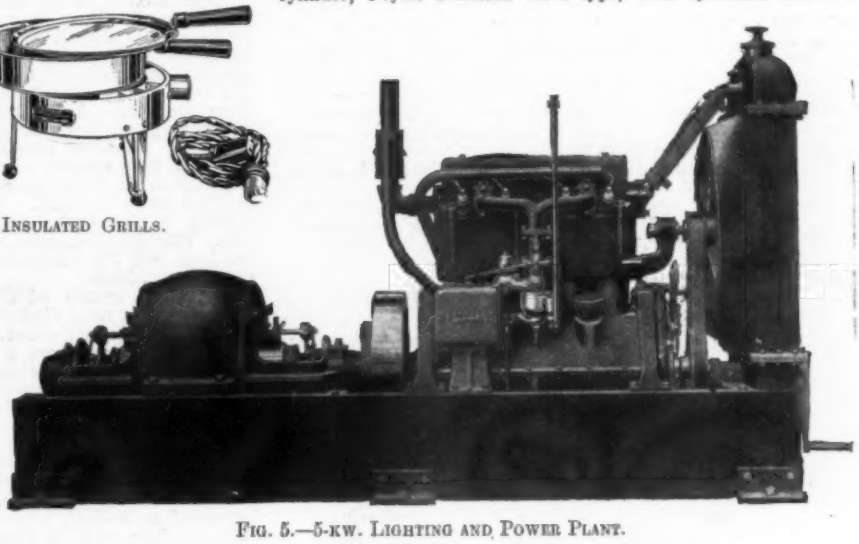

Fig. 5.—5-kw. Lighting and Power Plant.

A New Heating Element.

The accompanying illustration, fig. 6, shows a new type of heating element of very simple construction. It consists of a spiralised resistance wire enclosed throughout its length by closely fitting fireproof beads, which can be wound up in a flat spiral as shown; in this form it is used for enclosing in kettles, saucepans, &c., and in the "Etna" electric boiling ring illustrated in fig. 7, the top of which presents a red-hot disk about 5 in. in diameter in direct contact with the utensil to be heated, with very efficient results. The ring is loaded to 600 watts.

The element can also be made up in any suitable shape for use in electric ovens, grillers, &c., and as the conductor is entirely enclosed, perfect insulation is ensured, and risk of personal contact with it is obviated.

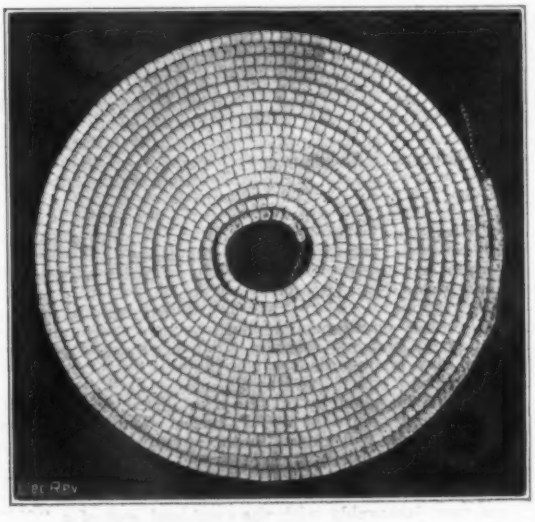

Fig. 6.—A New Heating Element.

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The patents for the construction of elements in this form are held by Mr. J. A. Colquhoon, of 29, Effra Road, S.W.,

Fig. 7.—The "Etna" Boiling Ring.

who will be pleased to receive applications for licences to use these elements in any form of cooking or heating apparatus.

A Worm Reduction Gear.

The London Electric Firm, Brighton Road, Croydon, is the manufacturer of the small (¼ h.p.) motor operated worm reduction gear, shown in fig. 8.

The worm is fitted with ball thrusts, plain journal bearings being provided for the worm wheel shaft.

Practically any speed reduction may be obtained by the use of single and double start worms, and where the reduction is considerable, by running two worms in series.

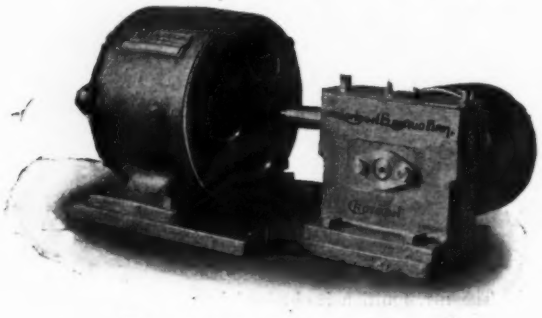


Fig. 8.—Worm Reduction Gear.

The unit is usually fitted to a combination bed which carries the motor, but may be fixed independently if desired. The primary drive may be direct, or otherwise, and in the case of the secondary drive, the shaft may be left bare or fitted with a pulley or sprocket, &c.

THE WILSON DIP-IN CUT-OUT FOR HOUSE SERVICES.

This cut-out was designed by a mains engineer to meet a definite demand which has arisen as a sequel to the new housing schemes, and it should be of particular interest to all engineers who are considering the question of mains and services in such schemes. A typical housing scheme in which this cut-out has been adopted was briefly described in our issue of July 18th, and the system was commended to the notice of supply undertakings by a letter from the Electrical Development Association in our following issue.

The dip-in wiring system has for many years superseded all other systems for the interior wiring of premises, but it was scarcely applicable to the outside distribution until houses began to be built simultaneously and in considerable numbers under the new housing schemes. Under these conditions each house may be regarded as equivalent to a "point" on an internal wiring system, and by means of the Wilson dip-in cut-out can be supplied by a two-wire distributor without any underground joints or "T" boxes. The system has many points which will appeal to the supply engineer; they may be summarised briefly as follows:—

No underground joints or "T" boxes. The Wilson dip-in cut-out is a "T" box and cut-out combined, and its price compares very favourably with the combined cost of a "T" box and cut-out.

It makes a sounder job when installed than was given by the old arrangement of "T" box and cut-out. The cable is "worked" at fewer points, and these points are always available for inspection, moreover, the points at which the cable is opened are above ground and on consumers' premises where the cable is far less liable to be damaged by the penetration of moisture than in the case of underground joints.

It gives the full capacity of the main in each house. This is a great advantage, as there is considerable prospect of the adoption of electric heating and cooking in the new houses in the near future, and a service put in now for lighting demand only may soon be inadequate if heating and cooking are installed. Moreover, as heating and cooking will inevitably be installed in some houses, which particular houses will be unknown at the date of laying the service, before the houses are tenanted, it follows that if the services are to deal with heating and cooking loads they must all be of sufficient capacity to do so. In this case possibly only a small proportion of the houses will eventually take a lighting supply only, which will mean that the capital costs of the large services will stand without an adequate return in the way of revenue, the revenue from lighting only being barely sufficient to cover the capital costs. The Wilson cut-out solves the problem by giving the full capacity of the main in each house. The supply engineer is then at liberty to canvas any consumer to install apparatus of any capacity without anxiety about the advisability of relying the consumer's service to avoid overheating or drop in pressure.

The cost of the dip-in system for housing schemes is not in excess of the cost of the old arrangement of one main in the road with services to each house. Under the new housing schemes the houses stand well apart and also well back from the road. This under the old scheme would mean many long services, and a great many "T" or service boxes—all points of possible breakdown. Under the dip-in system a twin conductor armoured cable is laid direct along the front of the houses on each side of the road, and is dipped in from house to house. Loop mains are adopted wherever possible so that each consumer can be supplied from either side. This gives increased reliability, a better distribution of the load, and the minimum drop in pressure up to the consumer's terminals.

The dip-in system with the Wilson cut-out gives a permanent control of the balance on a balanced system, whether this be a three-wire direct, or a four-wire, three-phase, A.C. system. This permanent control is the result of the accessibility of the main in each house, and is accomplished by varying the number of houses or the area fed by each polarity or phase. The point in the road up to which one polarity or phase feeds can be varied by disconnecting the live conductor of the distributor at two adjacent houses, leaving one conductor "dead" between the two houses and feeding from separate phases or polarities on either side up to the break in the live conductor. The position of the break can be varied as desired. Under the old arrangement all that could be done to balance systems was to supply equal numbers of houses from each phase or polarity, and as only some of the consumers installed heating and cooking apparatus, the system soon became hopelessly out-of-balance, and the only means of rectifying this was to dig up service boxes and change certain services over on to another phase or polarity—a very unsatisfactory method.

A point about the dip-in system which will appeal to the mains engineer is the ease with which faults can be located. Both ends of every length of cable are available, so that a location test can be at once taken without opening any ground. Also the main can be cut by removing a link in any cut-out, and the trouble located to a short length of main without any elaborate testing or opening of the roadway.

The cut-out is made in one size only, and will accommodate if necessary three 0.1 sq. in. two conductor cables, so that each cut-out can be used as a three-way distribution box, and the use of road and path boxes becomes unnecessary.

It consists of a rectangular case 13 in. by 4 in. by 7 in. neatly made of stout leaded sheet iron treated with a preservative paint, and has the usual sealing arrangements. The bottom portion of the front is made to slide off, and when in position forms the front of the sealing trough, the armour of the cables being finished immediately below a hardwood bush in the bottom of the cut-out, the lead entering to a point 1 in. inside the bush. The bush is supplied solid and slides in. It can be drilled by the user to take two or three cables up to 0.1 sq. in. in section, the bush being cut in two after drilling so that the front half can be slipped in after the work on the cables is finished and before the compound is put in.

The internal fittings are simple and effective, and consist of two 1 in. by ¼ in. copper strips to which the cable lugs are bolted by ⅜ in. round-headed brass screws and nuts. The two copper strips or bars are insulated from the hardwood blocks on which they are mounted simply and effectively by mica and porcelain insulators.

The armour of the cables can be bonded if required by means of wrought iron clips immediately below the cut-out, these being made for two or three cables as required.

The supply to the consumer passes from the "live" bar through a 15 ampere Dorman & Smith fuse, having a removable bridge piece which will withstand heavy overloads, and is too well known to need further description. The neutral conductor to the consumer is connected direct to the neutral bar and is not fused. The two rubber-covered wires are taken out of the top of the cut-out through substantial insulating bushes fixed by backnuts, so that the insulators do not fall down each time the cut-out front is opened.

Though designed especially for housing schemes, the cut-out can be used to replace an ordinary cut-out and "T" box on any distribution system, as in the case of two houses supplied by one service from the main. Feeder boxes can also be arranged in rectangular bases of ordinary street lamp columns.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

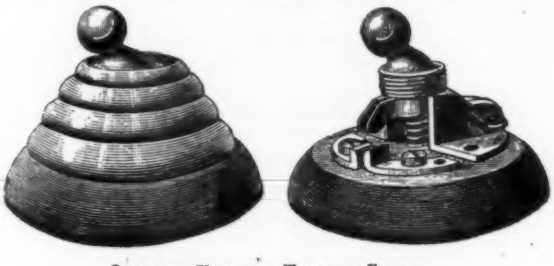
"Tumbler" Switches.

With reference to Mr. E. Fowler Clark's letter in your issue of April 16th, we are pleased to see that Mr. Robert T. Turnbull, of Wellington, N.Z., confirms the fact that Mr. A. B. Blackburn, late of the Edison Swan Co., was the inventor of the original type of tumbler switch.

Although our Mr. A. P. Lundberg is now in his ninetieth year, his memory and other faculties are still in excellent preservation, and he is of the opinion that either 1888 or 1889 was the year of the advent of the tumbler type of switch. We have unearthed from our museum of antiquities a sample of this original switch, and as a matter of interest, send it herewith for your inspection; also an Edison Swan Co.'s leaflet illustrating it.

You will note that the base is of slate, that the moving contacts have breaks of about 1/16 in., and that all the brass parts on the base are evidently hand-made from castings, paper finished and lacquered! The cover is the reeded dome type referred to in Mr. Turnbull's letter in your issue of August 6th.

It was undoubtedly the convenient up and down movement of the knob which popularised this type of switch, and caused it to become a standard in this country. In passing hurriedly a switch position, one can so easily flick the knob into its on or off position (a method of actuation much more convenient than that necessary for its predecessor, the "Turn Button" type of switch), even if it be fixed round a corner.



Original Ediswan Tumbler Switch.

Often, when laden, the article carried can be pressed into service to actuate the switch knob. Lazy and corpulent users have been known to express appreciation of its merits, when able to actuate, by means of the foot, switches fixed on the skirting board, usually for heating control.

The single-way type is self-indicative—knob up "off," knob down "on." The convenient rocking-knob action has been so far embodied in nearly a score of different types of switch, other than the single-way. We naturally think, something beyond spring modifications represents the improvement on the original pattern of 1888, *e.g.*, improved leverage with locking action, long and independent break, absence of jar, improved terminals and insulation, and general adaptability of these improvements and rearrangement of the parts to fulfil numerous requirements called for in modern switching.

It is interesting to note in the leaflet sent herewith that the switch illustrated is called the "tumbler." The word "tumler" was evidently a word coined for it later, apparently with the object of distinguishing it from its numerous imitations of hazy origin and meagre workmanship.

A. P. Lundberg & Sons.

London, N. 7.
August 11th, 1920.

[We duly received the switch and leaflet referred to, from which the above illustrations were reproduced.—Eds. Elec. Rev.]

"Extra-High Pressure."

In a leaderette this week you refer to the difficulty of finding an expression to replace "extra high tension" for the latest increases in high voltages. We have our "supermen." Why not appropriate a prefix so expressive, and use the term "super tension"?

P. Dunsheath.

Acton, W. 2.
August 14th, 1920.

[It is not considered desirable to use the word "tension" to signify "pressure" or voltage. The words have not quite the same meaning.—Eds. Elec. Rev.]

Professional Salaries and the Cost of Living.

I noticed recent editorial remarks, also those of correspondents, concerning the pay of the electrical engineers at Southampton and Wrexham.

This concerns the operating side, where the pay of engineers is in many cases public property, but it would be interesting to have an expression of opinion from yourselves and your readers about the pay of important officials on the manufacturing side, which is, I believe, in many cases also very poor under present conditions.

If £1,000 per annum is not over-generous for Southampton, and £450 is scandalous for Wrexham, what would be fair pay for, say, the chief of a technical department, aged not less than 40, with good and varied practical and designing experience, in, say, (1) a fairly leading company making switch gear, control gear, accessories, &c.; (2) a leading company making also A.C. and D.C. machines, &c. I think it would be fairly generally agreed that (1) would have carried quite £300, and (2) £400 before the war, now equivalent respectively to about £750 and £1,000. How many such officials are getting these figures?

Inquirer.

[It is important that justice should be done to essential men; otherwise their financial status stands far lower than in pre-war days. The merits of knowledge and training, and the high qualities of management, are deserving of adequate reward, and those who possess them will not be content to remain permanently at a disadvantage in comparison with those whose work they plan and control. Why should they? They will seek other fields—and we hope find them—probably to the detriment of their earlier undertakings or interests.—Eds. Elec. Rev.]

Submarine Cable Telegraphy.

I am at one with Mr. Raymond Barker in his desire that the expression for the "cable constant" be replaced or supplemented by one that will take into account the varying relativities of the factors involved.

When I used the expression "arbitrary constant." I merely embodied the idea suggested by Mr. Raymond Barker's suppositious case where B, before he can estimate the actual performance of the cable circuit, must know over what K R his speed constant is based.

To say that a particular circuit has a definite speed constant is a distinctly arbitrary statement, the so-called constant being dependent on the terminal conditions of the particular cable. With the rising curve of the so-called "speed constant," following on improved types of receiving apparatus, the term is clearly a misnomer; and it was with this in view that I applied the term "arbitrary" to the expression as currently used.

A. F.

LONDON ELECTRICITY SUPPLY, 1917—1918.

The London County Council return relating to electricity supply in and around London, which has just been published, is of considerable interest, and especially so since the provisional determination by the Electricity Commissioners of the area forming the London and Home Counties Electricity District. The proposed area is a large one, with a huge population, and it includes some hundreds of supply and other authorities. Proposals for the reorganisation of the electricity supply in the area will take some time to formulate; last November the L.C.C. appointed a committee, which hopes to report in the autumn, to prepare a scheme, and the local inquiry, when it comes to be held, will not be a simple or brief affair.

The return contains a list of the various authorities with the authorised areas of supply, together with an analysis of the accounts of each undertaking for the year ended March 31st, 1918, or December 31st, 1917, and also miscellaneous statistics relating to capacity, output, prices, assessments, &c.

In the area under consideration, namely, that comprising the administrative County of London and adjacent "extra-London" areas, the number of authorised distributors of electricity is 79, of which 40 are municipal concerns, and 39 companies. The number of Local Government areas containing authorised distributors is 135, the total acreage of which is 708,869, the population being 7,575,359, and the assessable value £65,843,460. The 36 distributors possessing statutory powers to do so, supplied 77,619,422 units in bulk in the period under consideration; of this amount 16,717,714 units were given by municipal and 60,901,708 by company undertakings. In addition a bulk supply of 1,226,536 units was received by St. Pancras from the L.C.C.; the Northwood Co. took 273,650 units from the Metropolitan Railway Co., and the Lots Road station sold 1,569,580 units to the Richmond Co.

The municipal undertakings had a total plant capacity of 203,852 KW., and that of the companies was 231,329 KW. The maximum load on the feeders (company figures being in parentheses) was 132,565 KW. (137,874); number of consumers, 119,590 (144,250); connections, 127,404 KW. lighting (121,523) and 174,168 KW. power and heating (107,310).

During the year under review municipal undertakings generated 372,560,419 units, from which 13,848,499 units purchased between undertakings has to be deducted. The companies generated 407,564,641 units from which 10,722,451 units purchased by municipal authorities have to be allowed for. The number of units sold by the municipal authorities was 308,743,598, and by the companies 318,869,018, the power factor being 28 and 25 respectively.

The statistics show that those municipal boroughs supplying electricity at the cheapest rates have made the largest profits, whilst those charging higher rates for electricity make

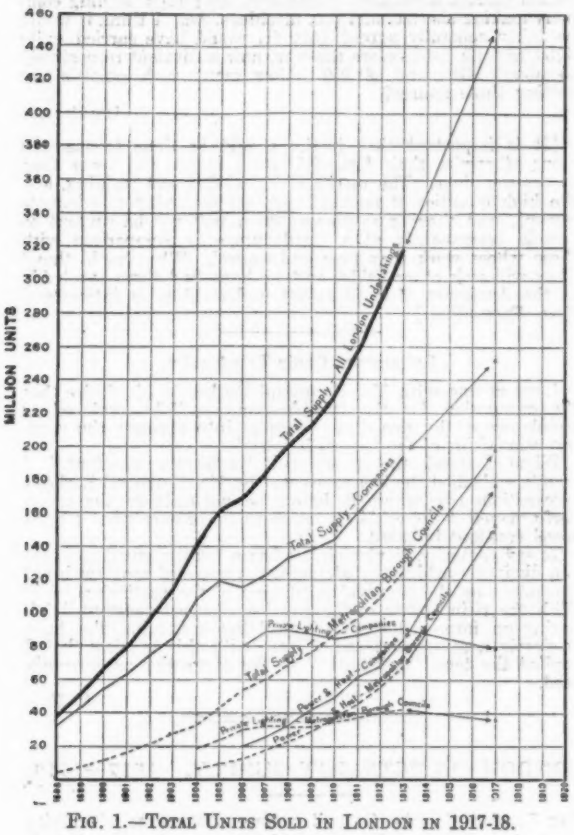


Fig. 1.—Total Units Sold in London in 1917-18.

a further charge upon the borough rates. The information available for the year ended March 31st, 1919, and tabulated in order of the cheapness of supply, is as follows, the first figures being the average price, the second the working costs per unit, and the third the surplus or deficit:—

Local Authorities.—Poplar, 1.48d., 1.06d., £8,948 surplus; Hammersmith, 1.55d., 1.28d., £1,347 surplus; Stepney, 1.61d., 1.02d., £22,245 surplus; Fulham, 1.63d., 1.22d., £9,058 surplus; Battersea, 1.64d., 1.23d., £1,118 surplus; Hackney, 1.64d., 0.94d., £9,308 surplus; St. Pancras, 2.10d., 1.89d., £20,239 deficit; Shoreditch, 2.14d., 1.55d., £1,487 deficit; Bermondsey, 2.18d., 1.59d., £1,679 surplus; Islington, 2.52d., 1.78d., £145 surplus; Stoke Newington, 2.78d., 2.24d., £850 deficit; St. Marylebone, 3.17d., 1.66d., £1,003 deficit; Southwark, 3.30d., 2.84d., £3,531 deficit; Hampstead, 3.72d., 3.04d., £13,144 deficit.

Companies.—The figures for the companies only deal with the average prices and working costs, as follows:—

	d.	d.
London Electric	1.60	1.27
South Metropolitan	2.39	1.49
South London	2.80	1.63
County of London	2.99	2.02
Westminster	31.7	1.92
City of London	3.70	2.50
Metropolitan	3.75	2.28
St. James's and Pall Mall ...	3.82	2.20
Charing Cross and Strand ...	3.83	2.67
Brompton and Knightsbridge ...	4.61	3.03
Kensington and Knightsbridge	4.64	3.28
Chelsea	4.90	3.28
Notting Hill	6.30	3.56

The London Electric Supply Corporation supplies largely in bulk to the L.B. & S.C. Railway, and, therefore, any comparison is not legitimate. The only company that can compare favourably with local authorities is the South Metropolitan Co.

In giving evidence before the (Sankey) Coal Commission, the engineer at Poplar submitted the following statement relating to undertakings in the Metropolitan area for the year 1913-14, viz.:—

	Thirteen companies.	Thirteen local authorities.	Two local authorities with company inception.
Income per unit	2·39d.	1·692d.	2·52d.
Working expr. per unit sold...	1·113d.	0·904d.	1·093d.
Management cost per unit ...	0·212d.	0·121d.	0·209d.
Depreciation or sinking fund	2·01%	4·22%	2·62%
Interest on dividend	4·97%	2·52%	3·3%

The statistics for the year ended March 31st, 1919, in the case of local authorities, and December 31st, 1919, in the case of companies, are as follows:—

	Thirteen companies.	Thirteen local authorities.	One local authority with company inception.
Income per unit sold ...	3·315d.	1·884d.	3·17d.
Working expr. per unit ...	2·186d.	1·355d.	1·66d.
Management cost per unit ...	0·332d.	0·184d.	0·15d.
Depreciation or sinking fund	3%	3·338%	2·13%
Interest or dividend	5·33%	2·917%	3·21%

In the case of the thirteen companies, the average charge advanced 34 per cent., and in that of the thirteen local authorities the increase was 11½ per cent.

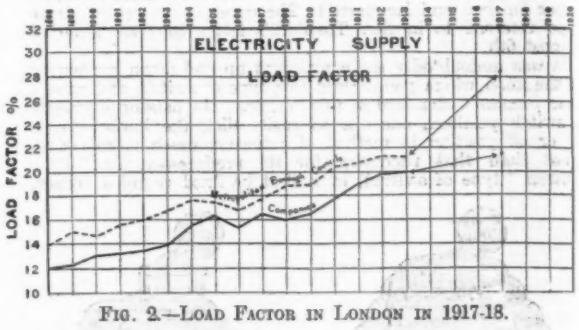


Fig. 2.—Load Factor in London in 1917-18.

The working cost in the former instance increased 96½ per cent., and in the latter 50 per cent., whereas management costs increased 56½ per cent., and 10 per cent. respectively.

The curves shown in figs. 1, 2, and 3 enable comparisons to

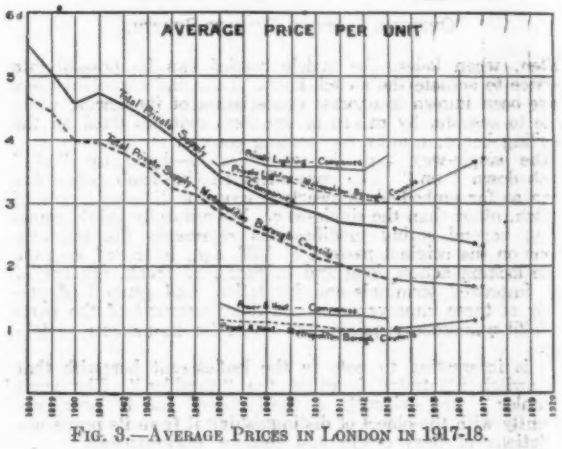


Fig. 3.—Average Prices in London in 1917-18.

be made between municipal authorities and company undertakings with respect to total number of units sold, power factor and the average price charged per unit in the year 1917-18. In fig. 1 the figures for power and heating exclude those for traction and bulk supplies.

Electric Coal Cutters in Australia. — Abolition Demanded.—Serious trouble has occurred at Mount Kembla Colliery. The employés declare that the mine is dangerous because of the large percentage of inflammable gas in certain sections of the pit, and the large quantity of dust created by the electric coal-cutting machines. It is stated that the machines cause sparks when they strike stone or brass or other foreign substances, and the risk of igniting the gas and the coal dust is too apparent to be regarded lightly.

The miners' district secretary states that since the introduction of electric coal-cutters there has always been uneasiness among the men because of the dust created and the danger of sparks. The upshot of these apprehensions was that at a recent meeting of the Mount Kembla Miners' Lodge it was decided not to go to work until the electric coal-cutters were abolished.

BUSINESS NOTES.

Bankruptcy Proceedings.—A. Kershaw and C. H. Wood (Kershaw & Wood), electrical engineers and merchants, 9, Bradford Road, Dewsbury.—Receiving order made August 6th, on debtors' own petition. First meeting, August 20th. Public examination, October 7th, both at Dewsbury.

J. Jagger (Jagger & Co.), electrical engineer, 28, Northgate, Halifax.—Trustee, Mr. A. Gray, 9, Fountain Street, Halifax, appointed August 9th.

E. S. Elam and J. Walton (trading as Elam, Walton & Co.), electricians, 63, King Edward Street, Kingston-on-Hull. The following are creditors:—

Atlas Advertising Association..	£31	Universal Advertising Co., Ltd.	£10
Bellamy, W. T.	11	Young & Peck, Ltd.	28
Edison Swan Electric Co., Ltd.	82	Scotter, Stanley	12
Jones, E.	11		

At the Hull Bankruptcy Court on Monday, the failure was attributed to want of capital, inexperience, and loss by fire. Walton, who is 24, said that some time after being discharged from the Army on account of ill-health, he and Elam commenced business in King Edward Street. He had no experience, but Elam said he had. The statement of affairs showed unsecured liabilities to about 61 creditors of £337, with assets £112, a deficiency of £225. The examination was closed.

Liquidations.—Armstrong, Stevens & Son, Ltd.—Meeting of creditors at 5, Waterloo Street, Birmingham, August 16th, under Section 188 of the Companies (Consolidation) Act, 1908. All debts have been, or will be, paid in full.

"Z" Electric Lamp Manufacturing Co., Ltd.—Winding up voluntarily. Liquidator, Mr. B. H. Binder, 80, Bishopsgate, E.C. A meeting of creditors is called for August 31st, at Orient House, New Broad Street, E.C. A communication, issued by Mr. W. Crawford and Mr. J. Scrivener, who have been associated with the company for many years, states that they are acquiring certain assets of the company, and will continue the business as a going concern. This will avoid interruption in the conduct of the business, and will provide for the payment in full of all creditors. A new company will be formed to operate from a London address, which will be announced later.

Tramways and General Works Co., Ltd.—A meeting is called for September 21st, at Finsbury Court, Finsbury Pavement, E.C., to hear an account of the winding up by the liquidator, Mr. E. C. Price.

Trade Announcements.—For the convenience of their Irish customers, Messrs. R. B. Hand & Co. have opened a branch at 44, Temple Bar, Dublin.

The Enterprise Manufacturing Co., Ltd., have appointed Mr. B. H. Heckie, of 58, Dundas Street, Glasgow, to look after their interests in Scotland.

Messrs. Jones & Pordes have appointed the following as sole agents for the sale of "Elba" dry cells:—Scotland—Mr. D. J. Esterson, 52, St. Enoch Square, Glasgow; Lancashire—The Arc Electrical Co., Trevelyan Buildings, Corporation Street, Manchester.

The Southern Electric Co., Ltd., have left 10, Bush Lane, Cannon Street, E.C. 4, and have taken temporary premises at 3, Cloak Lane.

Parliamentary Royal Assent.—The Royal Assent has been given to the following Acts:—

Post Office and Telegraph Act, 1920.
London Electric, Metropolitan District, City and South London, and Central London Railway Companies (Fares, &c.) Act, 1920.
Telegraph (Money) Act, 1920.

Catalogues and Lists.—British Insulated and Helsby Cables, Ltd., Prescot and Helsby, "Catalogo Geral" (40 pp.).—A Portuguese list of "Prescot" products, including cables, joint-boxes, switch and fuse-gear, cells, magnetos, &c.

Societe Francaise des Pompes et Machines "Worthington," 1, Rue des Italiens, Paris, agents for the "Terry" turbine.—A photographically illustrated description (30 pp.) of the "Terry" non-condensing turbine, giving constructional details and examples of installations. Also a leaflet (in French) giving a list of apparatus for which the company are agents.

Bell Battery Co., Ltd., Laburnum Grove, Ilford.—"A Silent Success"; an eight-page booklet dealing with various types of "Bell" dry cells, giving illustrations and a chart of performances.

The Palnut Co., Ltd., 6, Great St. Helens, E.C. 3.—Folder, giving an illustrated and priced description of the "Palnut" safety lock washer, together with samples of the device.

Automatic and Electric Furnaces, Ltd., 281-283, Gray's Inn Road, W.C. 1.—"Heat Treatment Bulletin," No. 23, "Concerning Pyrometers"; also a leaflet describing and illustrating a new pyrometer outfit.

Hyatt, Ltd., 24, Devonshire Street, Theobald's Road, W.C. 1.—A profusely illustrated catalogue (24 pp.), dealing with "Hyatt" roller bearings for many purposes, with photographs of installations in which they are employed.

The "Z" Electric Lamp Manufacturing Co., Ltd., Southfields, S.W. 18.—List SS. 16, monthly stock list of general supplies for August, including accumulators, lighting accessories, telephone apparatus and domestic electrical appliances.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Bulletins No. 13 (80 pp.) and 13A (50 pp.) Two well-illustrated publications dealing in an exhaustive manner with the construction and working of the various types of turbines manufactured by the company.

Disputes.—Electricians employed by the Scottish Contractors' Association are threatening to strike owing to the employers refusing their demand for a minimum rate of 2s. 3d. per hour. The employers have offered 2s. 1d., but this has been declined. In the meantime a ballot is being taken of the members of the Electrical Trades Union on the question of a strike. Over 2,500 men are involved in the dispute. As a majority of 50 per cent. was not obtained in the ballot of electricians on the question of affiliation with the new engineering Union, the Electrical Trades Union will continue to be a separate body.

Newspaper reports show that a conference in respect to the dispute at the Penistone Works, Sheffield, was held at York last Friday. The matter was discussed by the Emergency Committee of the National Federation of Employers and representatives of various Unions connected with the engineering and steel industry. It was made plain to the workers that the employers do not insist upon foremen or officials withdrawing from their Unions on appointment. Upon ascertaining this fact the workers decided to hold a conference with the Executive of the Electrical Trades Union at Manchester, on Tuesday this week, to discuss the whole matter. "As far as the electrical trades were concerned, it was intended to bring about a general lock-out in view of the Trades Union attitude at Penistone," but this intention was suspended at the suggestion of the general workers until after the meeting in Manchester.

The *Manchester Guardian* reports that the embargo on overtime which has been in operation for about a month among the men doing maintenance work in the engineering works of Manchester and other districts, has been extended by the adoption of a similar policy among the members of the Electrical Trades Union in the Manchester district. "The embargo was originally put into force by the local members of the Amalgamated Engineering Union for the purpose of enforcing an application for increased wages."

Catalogues Wanted.—The Kable Electrical Co., Ltd., of 41, Jermyn Street, St. James's, London, S.W. 1, want manufacturers' catalogues and price particulars.

Australian Trade.—The Commonwealth official returns of Australian Trade for the first half of the current financial year, include the following imports of electrical goods, cable, and wire, &c.:—

Imports.	*First 6 months,* 1918-19.	*First 6 months,* 1919-20.	*Increase on* 1918-19.
Electrical and gas appliances	£ 244,937	£ 329,044	£ 84,107
Electrical material, cable and wire (covered)	244,102	290,548	46,446

—*Industrial Australian and Mining Standard.*

The Leipzig Fair.—Twelve thousand firms will show exhibits at the Leipzig Fair, which is to open shortly.—*Times.*

Book Notices.—"Beama." Science Research Number II, August, 1920. Vol. VII, No. 2. London: Oakley House, Bloomsbury, W.C. Price 1s. 6d. net.

"The Theory of Electric Cables and Networks" (second edition). By A. Russell. (Pp. x + 348, 87 figs.) London: Constable & Co. Price 24s. net.

"Contact." The *Journal* of the National Association of Supervising Electricians. Vol. II, No. 1, August, 1920. London: The Association.

"Income Tax Up-to-Date." By H. J. Gully, F.C.A. London: *Financial News.* 9d.—Contains the Rules and Regulations relating to income-tax for 1920-21, and an explanation of the E.P.D., and the new Corporation Profits Tax.

Electric Lifts for Singapore.—H.M. Trade Commissioner at Singapore reports that a new firm who are just starting business in Singapore desire to take up an agency for British manufacturers of electric lifts. Owing to the shortage of office accommodation in Singapore, a considerable number of new buildings will be erected there in the near future, assuring a good market for lifts. The Department of Overseas Trade will give British manufacturers particulars of the firm referred to.

Annual Outings.—On Wednesday last week the employés of the Wakefield Corporation tramways department, with wives and friends, had an outing to Roundhay Park, Leeds, travelling from Wakefield by special car.

The employés of Messrs. R. Sutherland & Co., electrical engineers, Bolton, had an outing to Blackpool and Morecambe last week.

A Riga Exhibition.—We have received from the British and Russian Transport Co., Ltd., of 6, Lloyds Avenue, London, E.C. 3, particulars of the aims and organisation of the Brito-Latvian Trade Fair, which is to open at Riga in the last week in September, the postponement from the middle of this month having been decided upon in order to make the exhibition of a wider international character. The Fair will extend over five weeks in a building which can accommodate more than 500 exhibitors. Particulars of the classes of exhibits, and other arrangements, may be obtained from the above address.

New French Electrical Companies. — Lyons-France-Electrique (Montagnier et Faisant) is the title of a company constituted at Lyons (92, Rue de l'Hôtel de Ville) for the manufacture and sale of electrical apparatus. Its capital is 135,000 fr.

With a capital of 1,000,000 fr., the Ateliers et Spécialités Electriques et Mécaniques has been formed at Paris (22, Rue de la Banque) for the making of, and trade in, electrical and mechanical articles, and more especially electric clocks and other instruments of precision.

The Fil Electro-Email is the style of a newly-launched company whose object is the manufacture of insulators, and more especially insulated wire. Its offices are at 49, Rue de la République, at Lyons. Capital 200,000 fr.

There has been formed at Paris (218, Rue du Faubourg Saint Honoré) a company with the title of L'Electrique de Gonesse, for the manufacture of glow and other electric lamps and electric apparatus. Capital 650,000 fr.

The Société des Accumulateurs Monoplaque has raised its capital from 500,000 fr. to 1,250,000 fr. by the issue of 1,500 shares of 500 fr. each.

The directors of the Compagnie Electrique de Franche Comté are seeking sanction to increase the company's capital by the issue of shares to the extent of 562,240 fr.

The shareholders of the Etablissements Industriels E. C. Crammont et Alexandre Crammont have decided to raise the company's capital from 14,000,000 fr. to 30,000,000 fr. by the issue of new shares.

In order to carry out its development plans on the River Truyère, the Forces Motrices de la Truyère has decided to raise its share capital from 15,000,000 fr. to 30,000,000 fr., and to issue bonds for 15,000,000 fr.

To realise its schemes of extensions of its network, the Compagnie Centrale d'Energie Electrique is raising its capital from 20,000,000 fr. to 35,000,000 fr. by the issue of 30,000 500 fr. shares.

Foreign Trade.— July Figures.—The following are the values of imports and exports of electrical goods and machinery in July :—

	July, 1920.	*Inc. or dec.*	*7 months*, 1920. *Inc. or dec.*
	£	£	£
Imports.			
Electrical goods, &c. ...	142,258	+ 41,969	— 29,710
Machinery	1,689,320	+ 373,711	+ 2,032,066
Exports.			
Electrical goods, &c. ...	964,836	+ 435,018	+ 3,524,230
Machinery	7,344,057	+4,623,629	+16,553,147
Re-exports.			
Electrical goods, &c. ...	11,087	— 5,253	+ 8,706
Machinery	135,129	+ 85,730	+ 522,976

Chinese Students and International Trade.—Reference has been made from time to time to the advantages of attracting British and foreign students to this country from overseas to complete their education and training. There is an excellent case for devoting the Boxer indemnity to defraying the expenses of the technical education of Chinese students in the United Kingdom. It is understood that the British Government have such a scheme under consideration. France has set the example, and has made plans to pass a minimum of 6,000 Chinese through her technical and other schools, with the idea that they shall complete their training in French workshops. A similar programme is being carried out in the United States. An American engineer who is in charge of the Department of Mechanical Engineering at Peking University, has been very active in this movement and is trying to raise £1,200,000 in the United States for the provision of buildings and equipment for a new department of mechanical engineering at Peking University. The State which offers the greatest inducements to Chinese and other students to acquire industrial training and administrative experience will assuredly reap a rich reward in the future. Firms which train foreign students in their shops are engaged in excellent propaganda on behalf of British industries and commerce. One illustration may be given which may be regarded as typical. An engineering and shipbuilding works has recently been promoted at Canton by a student who has returned from the United States. He has placed orders in the States for the whole of the necessary machinery and equipment.—*Times Trade Supplement.*

Lead.—In their report dated August 14th, Messrs. G. Cawson & Co. say :—

> Lead has shown considerable weakness, and prices have steadily declined. Prospective arrivals are so heavy that there has been a great desire shown to get rid of early lead. The decline in price has been 30s. to 40s. per ton.
>
> The reports from almost all producing countries continues favourable for an increased output. The only unfavourable country is Australia, from which there is no news as to the settlement of the strike.
>
> The general home trade consumption shows no improvement; and even electrical works appear to be taking less lead. Then there is to be taken into account the continued heavy imports of lead products of all descriptions, which will naturally seriously interfere with the output of our own manufacturers, and have an unfavourable influence on the consumption of the raw metal.
>
> The outlook is certainly not encouraging. It must not be overlooked, however, that lead is still comparatively at a very high price, and a fall of even £5 per ton would still leave prices some 100 per cent. above the average of those ruling for the three years prior to the war.

Madrid Mint Equipment.—The Madrid Mint is about to renew its material, and as the Spanish industry will probably be unable to supply all the apparatus required, it is likely that the Mint will be obliged to acquire a certain quantity abroad.—*Reuter's Trade Service* (Madrid).

The Embargo on Overtime.—A correspondent states that serious inconvenience to Lancashire electricity undertakings is being caused by the embargo placed on overtime by the engineering Trade Unions. An illustration of how the embargo works under certain circumstances was given at Ashton-under-Lyne Town Council last week, when Alderman G. H. Coop, the chairman of the Electricity Committee, gave an instance of how the works were affected. One of their turbines, he explained, was undergoing its annual overhaul. Last Sunday evening a pinion driving the air-pump in connection with the condenser gave out. The fitters were sent for to repair it, but they refused to come, and the electrical engineer had to pull his coat off, and with what assistance he could get, undertook the job himself, in order to keep the station running. That was serious enough, but in addition one of the fitters who had had his holiday, now refused to work during Wakes Week, as previously arranged, although he had been paid for holidays. It had been arranged to overhaul the Bellis set during the Wakes holiday, but owing to this man's refusal to fulfil his obligations, the work could not be done.

The Melbourne Strike.—Australian papers just received contain particulars of the settlement arrived at between the newly-formed Consultative Disputes Committee of the Melbourne City Council and the chairman of the various Committees affected by the strike of engine drivers and firemen employed in the city's electrical undertakings. The final offer made by the City Council of 3s. 6d. per day increase for engine drivers was accepted with a corresponding addition to the differential increases previously offered to other employés. The men had claimed an increase of 4s. a day all round.

As the settlement of the dispute between the engine drivers and firemen and the Melbourne Electric Supply Co. was contingent upon the settlement of that between the men and the Melbourne City Council—both undertakings agreeing to pay the same wages—the whole of the trouble relating to electric supply and power is now practically at an end.

A comparison of the new offer with the former and with present wages is given below :—

	Present wages.	Minimum demanded by Association.	Latest offer by City Council's Disputes Committee.
	s. d.	s. d.	s. d.
Leading engine drivers	14 6	18 6	18 0
Engine drivers... ...	13 6	17 6	16 6
Leading firemen ...	14 0	18 0	17 6
Firemen and greasers...	12 6	16 6	15 6
Trimmers	11 6	15 6	14 6
Ashmen	11 6	15 6	14 6
Conveyor attendants ...	12 4	16 0	15 0
Switchboard attendants	14 0	18 0	17 0
Sub-station attendants	14 0	17 6	16 6
Dynamo attendants ...	11 9	15 6	14 6
Motor attendants ...	11 9	15 6	14 6
Cleaners	11 9	15 6	12 3
Boiler cleaners ...	11 9	15 6	12 6

The Norwegian Lamp Factory.—German Capital.—The only lamp factory in Norway—that of the A. S. Norsk Elektrisk Lampefabrik, of Drammen—is to pass into foreign ownership. At a special meeting of the shareholders, held on August 4th, a resolution was adopted deciding to dispose of the company's assets to a syndicate composed of the Norsk Elektrisk Brown-Boveri, Per Kure, the Auer Gesellschaft, and Siemens-Schuckert, and one-half of the capital is to be German. The new owners have reserved the right either to continue or suspend working at the factory, but it is stated that they intend to engage additional workers, so as to increase the production. Some time ago the Norwegian company decided to issue 700,000 kronor in preference shares, but as the amount subscribed was considered inadequate, this is one of the reasons for the sale. It is assumed that the purchase price will permit of the return of 50 per cent. of the ordinary share capital to the shareholders.

Government Contracts: The National Roll.—A Select Committee which has been appointed to inquire into the training and employment of disabled ex-Service men is reported to have recommended that the placing of Government contracts be limited, after a date to be fixed, to firms whose names are on the National Roll—that is, firms who are employing the percentage of disabled men fixed for their particular trade.

We recently referred to the excellent work that has been carried out at the Croydon Central Polytechnic by disabled ex-Service men (July 30th, p. 148). Mr. F. H. Taylor, who has been responsible for the course of training, desires us to mention that his assistant, Mr. V. A. M. Bulow, has had charge of the workshops for some time, and has taken the greatest possible interest in the work.

Conference at Olympia.—During the run of the Machine Tool and Engineering Exhibition at Olympia (from September 4th to 25th), there is to be a conference of employers and employed organised by the Industrial League and Council. It will take place on Tuesday, September 21st. There will be morning and afternoon sessions, between which luncheon will be held in the Banquet Hall. At the morning session the Rt. Hon. G. N. Whitley, M.P., will preside, and the Rt. Hon. G. N. Barnes, M.P., will open a discussion on "Unemployment and Production"; at the luncheon Mr. E. J. P. Benn will be the speaker; and in the afternoon, under the chairmanship of Sir George Paish, there will be a debate on "High Prices and World Competition," the Rt. Hon. G. N. Barnes, M.P., being the opener.

South African Iron and Steel Industry.—After an animated debate, the Union House of Assembly, on Friday last, confirmed, by 61 votes to 35, the draft agreement between the Pretoria Ironworks and the Government. The agreement stipulates that for a period of 17 years the Government railways will purchase 50 per cent. of their requirements in steel rails, &c., from the Pretoria Ironworks at imported cost. Vigorous criticism was directed against the agreement by the Unionist and Labour benches on the ground of creating a monopoly, especially, it was urged, as the Union Steel Corporation and other smaller producers had for years been promoting the iron and steel industry. General Smuts, in emphasising the benefits of developing the great iron and steel industry of South Africa, which had, he said, unique opportunities owing to coal and iron ore being plentiful and very cheap, and there being splendid resources of unskilled labour, pointed out that there was no question of monopoly, as the other 50 per cent. of the business of the railways was open to competition from everyone. The agreement before Parliament was also expressly subject to the prior agreement with the Union Steel Corporation. It was still in the power of the Union Steel Corporation to move on to success in their undertaking, and produce the whole of the Administration's railway requirements under their agreement for the next eight years. Sir Thomas Watt, Minister of Railways, claimed that no great steel industry could be established without the Government's assistance, and they considered the inducement offered to the Pretoria Ironworks an exceedingly cheap method of securing the establishment in South Africa of an enterprise requiring the investment of from £1,500,000 to £2,000,000 to assure manufacture on a large scale, because only on a large scale could such an industry hope to make good.—*Reuter's Trade Service* (Cape Town).

Copper and Lead Prices.—Messrs. F. Smith & Co. report, August 17th:—Electrolytic bars, £116, £1 decrease; electrolytic sheets, £158, £1 decrease; electrolytic wire rods, £132, £1 decrease; do. H.C. wire, ¼d. to ⅜d., ⅛d decrease.

Messrs. James & Shakespeare report, August 18th:—Copper bars (best selected), sheet and rod, no change; English pig lead, £38 10s., a reduction of 30s. per ton on last week's prices.

Further Reductions in German Export Duties.—The *Reichsanzeiger* publishes further alterations in the export tariff affecting wire, electrical machinery, telegraph and telephone apparatus and railway wagons. The following are now duty free:—Wire made of base metals (formerly subject to export duty of 3 per cent.), marine and underground electric cable (formerly 1 per cent.), and insulating tubes of paper or pulp (formerly 5 per cent.).—*Reuter's Trade Service* (Berlin).

The A.E.G.—The Allgemeine Elektricitäts Gesellschaft is proposing to increase its share capital by 250 million marks by a preference issue at 6 per cent. These shares will be redeemable from January 1st, 1925, at 115.—*Reuter's Trade Service* (Berlin).

Unemployment.—It is stated that about 50 per cent. of the workers of the semi-skilled class in Sheffield are unemployed. They have been stopped at Messrs. Firth's, Hadfield's, Brown's, Vickers', and other big works. In addition, workpeople have gone to Sheffield from other towns, where trade is falling off, and they are straight-away disappointed. This is increasing Sheffield's unemployment roll.

For Sale.—By direction of the Disposal Board, Ministry of Munitions, Mr. M. Marshall will sell by auction, on September 1st and 2nd, at Central Stores Depôt, Houston Station, near Glasgow, plant and machinery, &c., including motors, generating sets, electric cable, electric fittings, &c. For particulars see our advertisement pages to-day.

LIGHTING AND POWER NOTES.

Barking.—Electricity in Docks.—The County of London Electric Supply Co., Ltd., intends to erect at Barking a large generating station to supply the whole of the riverside area, including Tilbury.

Birkenhead.—Loan Sanctioned.—Sanction has been received by the Corporation to the borrowing of £20,000 for extensions to electricity mains and services, and £12,500 for electricity meters.

New Sub-Station.—Land owned by the Corporation at Ilchester Wharf is to be used for the erection of a high-tension sub-station.

British Columbia.—Water Power.—The potential water-power of British Columbia, experts declare, is equal to that of five Niagaras. Pouring down the mountains comes enough water to develop 3,000,000 H.P. At Niagara Falls, there is now developed about 725,000 H.P. Only 123,000 E.H.P. is now developed by the plants supplying Vancouver, New Westminster and the towns in that vicinity. This power turns the wheels of mills and factories, propels the tramway cars of these cities and provides light for the streets and homes. If the entire wealth of British Columbia in water were harnessed, it would be sufficient to provide power, light and heat for 40 cities the size of Vancouver and New Westminster combined. With this cheap power available, economists predict that some day the province will become one of the greatest manufacturing centres of Canada.—*Power*.

Clacton-on-Sea.—Electricity Charges.—The Ministry of Transport has informed the Urban District Council that, under the Order granted, the price of electricity must not exceed 11d. per unit.

Continental.—France.—The Chamber of Deputies has sanctioned the scheme submitted by the Minister of Public Works granting to the Orleans Railway Co. the utilisation of the Upper Dordogne River, in order to carry out the electrification of part of its lines. The State will carry out, at its own cost, the works necessary for the utilisation of hydraulic power and leave to the company the installation of machinery and the equipment of works and lines. The company will repay the State at a rate to be fixed by a special agreement. Any surplus energy will be sold by the company to third parties at rates which will be fixed by the Government. A reserve of power will be specially allotted to companies, trusts and agricultural and co-operative societies at preferential rates. The profits of the sales will be shared between the State and the Orleans company *pro rata* with their respective shares in the outlay on first establishment. The financial arrangement contemplates the constitution of an unique society formed by the State, the Departments, the communes and the Orleans company.

The French Société générale d'Enterprises and the Swiss Société Locher, of Zurich, have come to an agreement to build a dam on the Rhone, near the Swiss frontier, in connection with a hydroelectric station which is to be established at Pougny-Chancy, to yield 50,000 H.P. The Banque suisse des Chemins de Fer, of Basel, is financing the scheme.

The Compagnie électrique de la Loire et du Centre has decided to raise its capital to 60,000,000 fr., with a view to increasing its generating power, in order to supply its enlarged clientèle. Its plans embrace the construction of a 25,000-H.P. capacity water-power station on the Haute Loire; the acquisition from the State of an additional thermic generating group; shares in the Société d'Energie électrique de la Basse-Isère and in the Société hydro-électrique de l'Eau d'Olle, with a view to obtaining additional supplies, &c.

Switzerland.—There are over 16,000 electricity works in Switzerland, although the population is under 4,000,000. The electricity produced is used either for lighting, industrial purposes, electrochemical and electrometallurgical purposes, electric traction on railways, or for heating and cooking purposes. Rivers such as the Rhine, Aare, Reus, and the Limmet, have at various points been dammed at their full breadth, and the water used for the production of electric power.

A recent innovation in Switzerland is the tapping of mountain lakes (Kloenthal and Ritom), and the artificial creation of lakes for purposes of power production by damming up whole valleys. Such artificial lakes have advantages over wild torrents, inasmuch as the water supply can be regulated at will, and liberated or alternately retained, as may be required.

Before the war the Swiss power stations had altogether at their disposal more than 520,000 H.P., taken at a yearly average, the maximum being 887,000 and the minimum 345,000. The erection of electric power stations was delayed owing to the war, but did not come to a complete standstill. In spite of the unprecedented rise in the cost of labour and materials, great progress is now being made; the shortage of coal makes the erection of further power stations a matter of urgent necessity.

The amount of water power immediately available in Switzerland is estimated at 1,189,000 H.P. Of this amount the electrification of the railways will require 245,000 H.P., but it is estimated that power stations in Switzerland could be built to produce 8,000,000 H.P., and even more, or 20 milliards of KW.-hours per annum, whereas the power needed in Switzerland during 1914 is estimated to have been less than one-fourth of this amount. The shortage of coal caused by the war, which has been most bitterly felt, particularly in winter, has led to a tremendous demand on the part of the public for electricity. In addition to power and lighting, for which the electricity has, so far, been particularly used, electricity is now being employed to a much greater extent for heating purposes and for cooking, &c., in private houses as well as in public institutions.—*Board of Trade Journal*.

Dorchester.—Purchase of Undertaking.—The Dorset County Council has offered the County of Dorset E.S. Co. £9,000 for its Dorchester plant, subject to the necessary sanction being obtained.

Glasgow.—Year's Working.—The report on the electricity undertaking for the year ended May 31st last shows a gross revenue of £977,486, as against £865,039 in the previous year. The working expenses totalled £713,451, as compared with £567,259, leaving a gross surplus of £264,035 (£297,780). The payment of loan interest and sinking fund charges reduced this to £9,844 (£93,226). Writing off the depreciation in value of the plant resulted in a deficit of £54,614—met by the reserve fund—as contrasted with a surplus of £32,762 in 1918-19. The total number of units sold during the year increased by 2,721,523 to 146,223,311. The total capital expenditure during the 1919-20 period was £910,626.

Japan.—E.H.T. Transmission.—A 140-mile transmission line between Seto and Osaka, Japan, now under construction, will be operated at 160,000 volts, three-phase, 60 cycles, with neutral grounded through resistance. This is part of an extensive hydro-electric development programme involving an ultimate capacity of 200,000 KW. and transmission lines totalling more than 400 miles in length. The project is being undertaken in three successive steps of 30,000 KW. for the first, 70,000 KW. for the second, and 100,000 KW. for the third development. All of the power plants will be operated eventually in parallel over two circuits on a single steel-tower line having a capacity of 100,000 KW. The first development now under way is the construction of two plants, one of 9,000 KW. at Mosegawa, and one of 19,000 KW. at Seto.—*Electrical World*.

King's Lynn. — Electricity Supply.— The Town Council has decided to institute inquiries as to the probable consumption of electricity with a view to supplying the villages of Terrington and Clenchwarren by means of an overhead installation.

Lichfield.—Electricity Supply.—The Town Council has appointed a Committee to meet a deputation from the Walsall Town Council, and discuss the question of a supply of electricity for the city, by means of a proposed cable to supply Whittington Barracks.

London.—Price Increase.—The Charing Cross, West End, and City E.S. Co. has applied for permission to increase its maximum charge to 8d. per unit, instead of 6d. to put it on terms of equality with other supply companies in the Metropolitan area.

Woolwich.—In order to comply with the Electricity Commissioners' wishes that the electricity undertaking should be further developed, the Council has decided to carry out plant extensions at an estimated cost of £200,000, and extensions of mains costing £30,000.

Market Drayton.—Public Lighting.—In connection with the lighting of the district during the coming winter, the Urban District Council has accepted the tender of the Market Drayton Electric Light Co. at £4 10s. per lamp.

Newcastle (Co. Down).—Public Lighting.—The Urban Council has agreed with the Electric Lighting Co., Belfast, for a supply of electricity for public lighting at £340 per annum, with 100 lights of 50 c.p. each, 34 of 25 c.p., four of 100 c.p., and five of 200 c.p.

Portrush.—Electricity Scheme.—Mr. A. D. Price, engineering inspector to the Local Government Board for Ireland, held an inquiry recently into the application by the Urban Council for sanction to a loan of £15,000 for constructing electricity supply works. Evidence dealing with the financial, commercial, and other features of the scheme was given by Mr. W. Pleavance, consulting engineer, and others. The Town Clerk said a rate of 1s. 9½d. in the £ would cover payment of principal and interest, spread over a period of 25 years, in the case of the electricity loan, and a further loan for £2,000 for the purpose of providing lands for use as pleasure grounds. Mr. S. A. Wray, Cloraine, on behalf of residents in the Dhu Varren district, urged the immediate inclusion of that district in any electric lighting scheme that might be carried out. The Inspector will report in due course.

Shipley.—Electricity Supply.—The Urban District Council has decided to raise no objection to the proposed application of the Yorkshire Electric Power Co. for a Provisional Order to supply electricity within the district, provided no monopoly is created. The company has informed the Council that if the Order is granted, full protection will be given to the Council on this point.

Sligo.—Public Lighting.—By a majority, the Corporation has accepted the offer of Mr. T. Kilgannon, Thomas Street, to install and maintain public electric lighting, beginning with 15 lamps—nine of 200 c.p., and six of 100 c.p.—and as many other lamps of 50 c.p. as may be required within a specified area, the price to be 1s. per unit—subject to revision every three years, according to increase or reduction in price of coal and Trade Union labour.

Thorne (Yorkshire). — Electricity Supply.— The Electrical Distribution of Yorkshire, Ltd., is to apply for a Provisional Order to supply electricity for all purposes within the township and the rural area of Thorne. Mr. Wells, on behalf of the company, interviewed the Rural Council last week. It was pointed out that two local colliery companies at Hatfield and Thorne, would oppose the Order, and that the Stainforth Colliery Co. is already supplying its own houses with electric light. Mr. Wells said the company was satisfied that, despite these facts, a supply to the district could be made to pay. The opinion was expressed at the meeting that no colliery company would be willing to become general distributors, although it would probably be prepared to supply energy in bulk. The Council, before coming to a decision about the electricity supply company, decided to inquire from Messrs. Pease & Partners, colliery proprietors, and the Hatfield Main Colliery Co., whether they would be willing to supply and distribute their spare power for public lighting in Thorne, and to undertake the work which the E.D. of Y. Co. proposed to do.

Tasmania.—Water Power.—It is announced that the Tasmanian Government intends to introduce legislation during the forthcoming session of Parliament for the purpose of dealing with the question of the rights of the Crown to the waters of the State, and establishing an authority to control them, carry out systematic gaugings, surveys, &c., and especially to consider the question of the utilisation of waters for the various purposes of power, irrigation, domestic supply, and mining.

The Government has also instructed the chief engineer and general manager, Mr. J. H. Butters, to proceed to the United Kingdom and North America in the near future, to investigate systems of management of electricity supply undertakings, to study the results that have been obtained, and the working of existing legislation, with a view to devising the soundest possible scheme to suit conditions for the control of hydro-electricity in Tasmania. Mr. Butter's mission is also to obtain machinery for enlarging the power scheme as already decided upon, and now involving an outlay of £2,500,000.

It is officially stated that Tasmania is at the present moment committed to an enormous works programme in connection with the hydro-electric scheme, which will exhaust all the available labour and funds during the next three years.—*Times Trade Supplement.*

Taunton.—Electricity Area.—The Town Council has asked to be excluded from the Lower Severn electricity district, on the ground that the cost of linking up would be out of all proportion to the possible benefit, and recommending that if the town is to be included in some area, it should be in the same one as Exeter.

Twickenham.—Electricity Charges.—At a conference of local authorities, it was decided to recommend the Ministry of Transport that an increase of 2d. per unit, making the charge 1s., would be acceptable, and failing the acceptance of this by the E.L. Co., the application for the maximum charge to be fixed at 1s. 2d. should be opposed.

Whitehaven.—New Plant.—The Town Council has decided to apply for a loan of £12,000 for a generating set.

Winchester.—Year's Working.—The figures given in the statement of accounts for the year ended March 31st last, are as follows, the figures given in parentheses being the corresponding results for the previous year:—Total revenue, £25,986 (£18,095); total working expenses, £17,333 (£11,839); gross profit, £8,653 (£6,256) and net profit, £2,686 (£626). The total number of units sold increased by 186,394 to 1,326,466.

Woking. — Overhead Transmission. — The Urban District Council has consented to the Electric Light Co. erecting an overhead cable in the district for the transmission of energy.

TRAMWAY AND RAILWAY NOTES.

Argentina.—Railway Electrification.—Among the various improvements and extensions on which the Central Argentine Railway contemplates spending 40,000,000 pesos is the electrification of the line to San Martin, which it is hoped to put in hand shortly, the preliminary calculations and plans now being completed.—*Reuter's Trade Service* (Buenos Ayres).

Burnley. — Wages.— The Tramways Committee, on August 12th, decided to approve of any agreement arrived at between employers and employed in the engineering trade in connection with the present application for a wage increase. If the overtime embargo continues and is applied to fitters, it is probable there will be no Sunday service, and a reduced Saturday service of cars in the district.

Continental.—Russia.—Moscow reports that the first electric train in Russia has been built in the Baltic works, and that it will have a speed of 31 miles an hour.—*The Times.*

Italy.—At the second session of the Consiglio Superiore delle Acqua it was decided, in the matter of the electrification of the Italian railways, that the existing three-phase system should be maintained throughout the zone northward of the Pisa-Florence-Faenza line; that continuous current should be used on the Benevento-Foggia section; and that, experimentally, industrial frequency three-phase traction should be employed on the Rome-Tivoli and Rome-Anzio lines.

Hull.—Wage Increase.—On August 13th the Corporation Tramways Committee decided to grant its traffic employés an extra 1s. per week, to make up the 10s. advance demanded by the men, though the national award was for 9s., leaving local authorities with power to give the extra shilling or not. It was stated at the meeting that practically every other tramway authority in Yorkshire had given the extra shilling.

Jamaica.—Railway Electrication.—A mail dispatch from Kingstown, Jamaica, says that the Government has under consideration a scheme for the electrification of the railway system in that island, and that the British Admiralty looks favourably on the project. Considerable improvements are under review, the net effect of which will greatly help trade and commerce.

London. — "Underground" Fares. — The London Underground railways have issued a statement with regard to the Fares Act, which was among the private measures to receive the Royal Assent on Monday. The revised fare rates are being prepared at the "Underground" headquarters, but it is not anticipated that they will come into operation until the end of next month. It is explained that the new powers granted to the companies under the new Act will permit the continuance of the policy of preference to the long-distance passenger, who is, generally speaking, an employed person of the industrial, business, or professional class, and, therefore, a regular traveller. Under the Act, the "Underground" systems are empowered to charge ordinary fares at a rate not exceeding 1½d. for a mile or part of a mile, with a minimum of 2d.; while "workmen's" tickets will be issued up to 7.30 a.m. on all the systems, and will be available for the return journey any time during the day at rates not exceeding the ordinary single fare for the double journey, with a minimum of 3d. (return). These, how-

ever, are maximum powers of charge, designed to provide the companies with a reasonable margin within which to operate, without the necessity of constant reference to Parliament. Even for short journeys in the inner areas it may not be necessary to make full use of the maximum powers of charge. The necessary increases will be imposed where they will be least felt, and the long-distance fares under the new schedule will still be found to work out at a very cheap mileage rate, both positively and relatively.—*Morning Post.*

Southend-on-Sea.—Extensions.—The Light Railway Commissioners have granted the Town Council an order for the extension of the electric tramways.

Southampton. — Strike. — On the afternoon of August 15th the tramway employés ceased work on account of the dismissal and refusal to reinstate one of their members. An offer to take the man back when a vacancy occurred was refused.

Southport.—Time Extension.—The Minister of Transport has extended the time of the Southport Corporation Act for the completion of the electrical equipment and apparatus for the working of trolley vehicles until August, 1921.

West Ham.—Year's Working.—The results of working for the year ended March 31st last are given below, the previous year's figures being shown in parentheses:—Total revenue, £283,345 (£237,487); total expenditure, £253,694 (£215,019); gross profit, £29,651 (£22,468); net deficiency, £44,777 (£7,703).

TELEGRAPH AND TELEPHONE NOTES.

Austria.—Strike.—The Post Office notified during the week-end the temporary suspension of the telegraph service with Austria, owing to a strike in that country.

Costa Rica.—Wireless Telegraphy. — The *Gaceta Official* (San José) of June 10th publishes the following decree, which may interest United Kingdom firms:—

The Executive Power is authorised to employ the sum of 250,000 colons from the Public Treasury in the purchase and installation of a wireless telegraphic or telephonic station of sufficient power to obtain direct or indirect communication with the places in the world where wireless-telegraphic and telephonic, cablegraphic, or telegraphic public offices have been opened. This station must be established by preference in the capital of the Republic. From the same sum will be taken the amounts necessary for the purchase and installation of sub-stations in distant regions of the national territory, and by preference in the cantons of Osa, Puntarenas, and Liberia, and in the region of Siscaola in those places in which the towns and State may derive the best service and in which the exigencies of wireless-telegraphic technique may be satisfied. Decree No. 34 of April 10th of the current year, issued by the Government of Dr. Francisco Aguliar Barquero, is ratified, by which the wireless telegraph and telephone are declared of public utility and State monopolies.—*Board of Trade Journal.*

Ecuador.—Wireless Telegraphy.—According to *La Prensa*, of Lima, the Government, in order to set up speedy means of telegraphic communication across the mountainous regions of the Republic, is contemplating the establishment of a wireless network, and has placed the contract with the Société Française Radioelectrique. The stations forming the network will number five of 10 kw. each, five of 5 kw., three of 1 kw., and one of 70 kw.

France.—Wireless Telegraphy.—The re-organisation of the French systems of posts, telephones and telegraphs and the amplification of the wireless network were the subjects recently of a speech by M. Deschamps, under-secretary of the department concerned with these services. Existing stations, said M. Deschamps, already had received or forwarded 4,500 radio-telegrams in January, 4,800 in February, and 5,730 in March. The long-distance network organisation was under weigh. While awaiting the establishment of a station specially designed to exchange radiograms with the great European stations, the Administration purposed utilising the Tour d'Eiffel station, and perhaps that of Doua, near Lyons, and, if agreeable to the Ministry of Marine, the station of Basse Lande, at Saint Philibert de Grand Lieu. There was already a service of several hours' duration daily with Hungary, and another was about to be opened with Belgrade. Negotiations had been begun with the American Radio Corporation with a view to setting up connection with Tuckerton, when inaugurated, and the Doua station. The last-named would only be used for Franco-American traffic until the completion of the Croix d'Hins station, near Bordeaux. Lastly, the Administration, in agreement with the Ministry of the Colonies, had framed a programme for a network of very powerful stations directly linking the French capital with all its oversea colonies. The construction of the colonial network would take some time, but meanwhile a temporary system was under consideration for the use of the Press, and private telegrams by means of fairly powerful stations linked up to the Doua station and that of Croix d'Hurs, which will shortly be working. This programme, M. Deschamps says, when completed, will render France independent of the English system.

Georgia (Russia).—Wireless Station.—Negotiations are under way between the Georgian Government and a French company for the establishment of a powerful wireless station Tiflis.

Holland.—Wireless Telephony.—By arrangement with the Government the Committee of the Amsterdam Bourse has made provision for the introduction of a system of wireless telephony next month in connection with transactions with the provinces and with Rotterdam, says the *Financial Times.*

Ireland.—Secret Wireless.—Last week a complete wireless installation was reported to have been found in a house at Drumsna, Co. Leitrim; the police attach much importance to the capture of the installation.

Italy.—Automatic Telephones.—The intention of the Government to spend 10,000,000 lire on the introduction of automatic telephones has been linked with the statement that native firms are to be passed over, and the orders placed in Germany. The *Tribuna* explains that the Government, not to compromise the success of its large scheme, was bound to invite competition. During the war there was an agitation against orders for automatic telephones being placed with the English Siemens Co. and with the Western Co., and as a consequence, the Società Construttori Telefoni Italiani was constituted, consisting of the five principal firms specialising in this branch, namely, the Società Industrie Telefoniche Italiane, the Società A. Perego, the Società Telefoni Privati, the Società Adriatica Telefoni, and the Società Giulio Galanti e Ca. There seems little risk of the Government passing over the native industry.

Liverpool.—Wireless Fire Call.—The Fire Brigade last week experimented in calling the brigade to a scene of fire by means of wireless telegraphy. A similar test was recently made in London.

Shanghai. — New Wireless Station. — A powerful wireless station, which will be available for commercial and official purposes, is to be established at Shanghai, says *The Times.*

Ships' Wireless.—D.O.R.A. Regulation Revoked.—An Order in Council, published in the *London Gazette* of August 13th, revokes, from September 1st, Regulation 37 B, under the Defence of the Realm Regulations, which made it compulsory for every British ship of 1,600 tons or over to be provided with a wireless outfit, and to carry two certified operators.

United States. — New Wireless Service. — The "Naval Communication Service" began on August 17th, when commercial, private, and Press messages were accepted for transmission to France by wireless. The commercial rate is the same as that charged for messages sent by cable, while the Press rate is 10 cents a word. Messages will also be accepted for Belgium, the Netherlands, Italy, Switzerland, Luxemburg, Czecho-Slovakia, and Jugo-Slavia, *via* Lyons.—*Financial Times.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review, *in which the "Official Notice" appeared.*

OPEN.

Australia. — Commonwealth Government. November 24th. Protected cable terminals and cable distribution boxes. Specifications &c., will be available at Australia House, Strand, W.C.—*Reuter's Trade Service.* (Brisbane).

Victoria.—October 20th. Victorian State Rivers and Water Supply Commission. Two 1,600-B.H.P. steam turbines, with mechanical reduction gearing and condensing plant.—*Reuter's Trade Service* (Melbourne).

Azores.—September 28th. Specifications (in Spanish) of electric lighting plant, required for the city of Ponta Delegada S. Michel, Azores, may be seen on application to Capt. Vandeleur, Department of Overseas Trade, London (Room 48).

Belgium.—September 10th. Municipal authorities at Antwerp. Switchgear boxes required for the electric cranes to be erected on the quays of the new docks (Nos. 2 and 3). Three-phase, alternating, 300 volts. Specifications (in French) may be seen on application to Capt. Vandeleur, Room 48 (Department of Overseas Trade, London).

Birmingham. — September 1st. Salvage Committee. Two 100-kw., 440-v., d.c., compound-wound, steam-driven generating sets, complete with surface condenser and switchboard. (July 30th.)

Blackpool.—August 27th. Corporation. Two water-tube boilers, superheaters, economisers, stokers, &c.; two sets of induced draught plant; coal conveying, &c., plant. (July 16th.)

Bolton.—September 16th. Electricity Department. One 12,000-kw. turbo-alternator. (See this issue.)

Bradford. — September 9th. Electricity Committee. Contract R. 159. No. 4 boiler house and equipment, including buildings, water-tube boilers, economisers, induced draught plant, feed pumps, coal-handling plant and piping systems. (August 6th.)

Cape Town.—August 23rd. The Department of Overseas Trade has received specifications for transforming apparatus, switchgear, poles, cross arms, insulators, house connections, street lighting fittings, switches, lightning arresters, &c., for the electric lighting scheme at Mossel Bay. Copies may be seen at the office of the Department, Room 48 (Capt. Vandeleur), but it should be noted that Monday, August 23rd, is the closing date for tenders.

Chile.—February, 1921. The Chilean Legation at Paris (23, Avenue du Bois de Boulogne) is asking for tenders for the supply and installation of electric power in the first zone of the Chilean railways. Sealed tenders are returnable before February 1st, 1921.

Croydon. — September 8th. Tramways Department. Supply and installation of a new feeder cable. (August 13th.)

Edinburgh.—September 6th. Electricity Department. Converting plant for Portobello generating station and sub-station. Specification No. 26. (August 6th.)

India. — AGRA. — October 22nd. Municipal Board. Complete generating plant, comprising: four Diesel engines and H.T. alternators; H.T. and L.T. switchgear, transformers and sub-station equipment; 15 miles underground H.T. cables, 28 miles overhead L.T. three-phase mains and street lighting equipment, complete with all accessories. (See this issue.)

London. — WALTHAMSTOW. — September 8th. Urban District Council. Electricity Department. Two water-tube boilers and economisers; one 5,000-KW. turbo-alternator and condensing plant; one 1,500-KW. and one 1,000-KW. rotary or motor converters; one natural-draught cooling tower; E.H.T. and L.T. switchgear; E.H.T. cables. (August 13th.)

WEST HAM.—September 9th. Board of Guardians. Electrical fittings for six months. Mr. T. Smith, Clerk to the Guardians, Union Road, Leytonstone, E. 11.

Manchester. — August 30th. Electricity Committee. Barton power station: 33,000-volt, 3-phase trunk feeders (26 miles), pilot cables (104 miles), telephone cables (19 miles). Specification B. 7. (August 6th.)

August 24th. Electricity Committee. One steam turbine-driven boiler-feed pump, for Stuart Street generating station. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall. Deposit £1 1s. (returnable).

September 2nd. Markets Committee. Pumps, motors and fittings, for Smithfield and Elm Street cold stores. Specifications, &c., from General Superintendent, Markets Department, Town Hall.

September 20th. Electricity Committee. Six 33,000-volt, 19,500 K.V.A., 3-phase static transformers, house service and testing transformers. (August 6th.)

Nuneaton.—September 20th. Electricity Department. H. and L.T. switchgear, connecting cables and accessories. (August 13th.)

Portsmouth. — August 25th. Electric Lighting Committee. One 4,000-KW. turbo-alternator; two water-tube boilers, each of 30,000 lb. per hour capacity. (July 30th.)

South Africa.—JOHANNESBURG.—September 6th. Gas and Electric Supply Department. Class A. One or more light electric passenger vehicles. Class B. One or more light electric delivery vehicles. (August 13th.)

Stockton-on-Tees.—August 30th. District Fund, Gas and Electricity Committees. Articles and stores for six months. (August 13th.)

Spain.—The Direccion General de Correos y Telegrafos, invites tenders, up to the end of the month, for the supply of 40 tons of electrolytic copper wire of 3½ m/m dia., to be employed on the telegraphic lines from Bilbao to Gibraltar and Madrid to Bilbao. —*Reuter's Trade Service.*

Uganda.—December 20th. Government of the Uganda Protectorate. Tenders invited for a concession of a portion of the Ripon Falls of the Nile. See this column in our issue of July 30th.

Warrington.—September 7th. Electricity and Tramways Committee. Surface condensing plant. (August 6th.)

CLOSED.

Glasgow.—Electricity Committee. Recommended :—

Nine 1,875-K.V.A. step-down transformers, £29,211.—Met.-Vickers Electrical Co., Ltd.

Nine 1,875-K.V.A. step-down transformers, £29,865. — British Electric Transformer Co., Ltd.

New Zealand. — The New Zealand Government has ordered from Messrs. British Electric Vehicles, Ltd., of Southport, three of their locos. to haul loads of 20 tons, complete with three motor-generator sets, switchboards and all the necessary accessories. They are for use in conjunction with the hydro-electric schemes which are being carried out in New Zealand.

Sunderland.—Council. Accepted by Electricity Committee :—

B. I. & Helsby Cables, Ltd.—Cable.

Armstrong, Addison & Co.—Creosoted redwood troughing and creosoted capping.

FORTHCOMING EVENTS.

British Association for the Advancement of Science. — 88th annual meeting at Cardiff, from August 24th to 28th inclusive.

Tuesday, August 24th. At 8 p.m. In the Park Hall. Presidential address on "Oceanography," by Prof. W. A. Herdman, F.R.S.

NOTES.

Institute of Metals.—The autumn meeting of the Institute will be held at Barrow-in-Furness, on September 15th and 16th.—An attractive programme has been arranged, which includes civic receptions, social functions, &c., visits to iron and steel works in the district, and visits to the Furness Railway works, the Barrow paper mills, and the Hodbarrow mines. During the meeting the following papers are expected to be submitted for discussion :—

W. E. Alkins, M.Sc., on "The Immiscibility of Metals from the Point of View of the Phase Rule."

Eng. Lieut.-Comm. G. B. Allen, R.N., on "Service Experience with Condensers."

T. G. Bamford, M.Sc., and W. E. Ballard on "The Influence of Gases on High-Grade Brass."

Kathleen E. Bingham, B.Sc., on "The Allotropy of Zinc."

Prof. H. C. H. Carpenter, F.R.S., and Constance F. Elam on "Crystal Growth and Recrystallisation in Metals."

J. H. S. Dickenson, "Note on a Failure of Manganese Bronze."

D. Hanson, M.Sc., and Marie L. V. Gayler, B.Sc., on "The Constitution of the Alloys of Aluminium and Magnesium."

O. F. Hudson, D.Sc., and J. H. Darley on "The Constitution and Structure of Certain Tin-Antimony-Copper Alloys."

F. Johnson, M.Sc., on "Some Features in the Behaviour of Beta Brass when Cold-Rolled."

R. T. Rolfe, F.I.C., on "The Effect of Increasing Proportions of Antimony and of Arsenic respectively upon the Properties of Admiralty Gun-Metal."

H. B. Weeks, F.I.C., "Notes on Brass-Foundry Practice at Messrs. Vickers, Ltd."

Engineering Tool Standards.—A report (1s. 3d., post free) issued by the British Engineering Standards Association, 26, Victoria Street, S.W. 1, deals with British standards for milling cutters and reamers. The first part of the report gives definitions of the various classes of these tools, followed by a series of definitions of various types of each class, each type being accompanied by an explanatory diagram. The second part contains 58 tables, giving the standard dimensions and tolerances of the various tools, including tables of Brown and Sharpe and Morse tapers. Standard dimensions for arbors and keys and keyways are also given.

Charity Sports Meeting.—The C.A.V. Athletic Association is holding a closed and open sports meeting to-morrow on its ground at Old Oak Road, Shepherd's Bush, in aid of the Acton Cottage Hospital. Such a worthy object should ensure a large number of visitors; the meeting comprises many open events, besides those confined to the London business houses, and, after the sports, there will be a concert and dancing.

Floating Exhibitions.—A committee of Italian business men has chartered a yacht which is to visit North African and Spanish ports and Marseilles this month, for the purpose of exhibiting the products of 1,200 Italian firms.

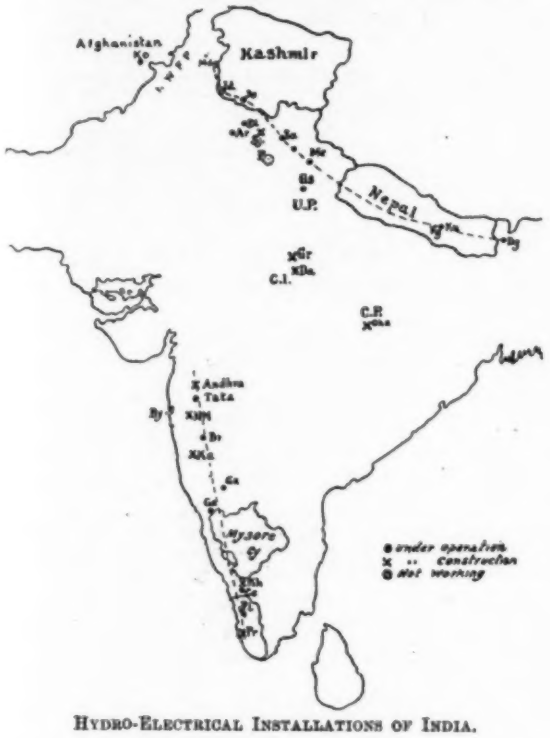
An ex-German 2,000-ton vessel is being refitted at Brooklyn before making a world business tour. She will carry 1,500 exhibits of U.S. manufacture and will make a year's voyage to South America, Europe and Asia. The trip has been organised by a company of U.S. business men.

Electricity in Italy.—The total consumption of electrical energy in KW.-hours in Italy in the last six working years was as follows :—

Years.		KW.-hours.	Difference—KW.-hours.
1913-1914	...	2,311,930,347	—
1914-1915	...	2,573,017,931	+ 264,000,000
1915-1916	...	2,859,724,982	+ 286,000,000
1916-1917	...	3,796,719,209	+ 937,000,000
1917-1918	...	3,391,588,933	+ 595,000,000
1918-1919	...	3,733,285,191	+ 342,000,000

Sentence.—At Hull Police Court on Monday, George Knight, chief electrical engineer to the British Oil and Cake Mills, Ltd., was sentenced to eight months' imprisonment in the second division on charges of theft. It was stated that the goods stolen, and the cost of the firm's labour employed on the residence prisoner was building, totalled in value £1,400. The defence was that accused, who was suffering from consumption, succumbed to temptation in his anxiety to provide for the future of his wife.

Electricity in India. — Considering the pre-eminent importance of irrigation in the Province of Lahore, it is not surprising that the majority of the papers contributed to the Lahore Engineering Congress should have dealt with that subject, says *Indian Engineering*. Nevertheless, the paper by Mr. F. L. Milne, A.M.I.E.E., on a "Project for Providing the Punjab with a Cheap Supply of Electric Power," was welcome. The electrical industry in India is notoriously very backward; the figures given by Mr. Milne, according to the journal referred to above, show that while in India the number of watts installed per head of population is only 0·742, the corresponding figure is 33 for the British Isles, 148 for Canada, 61·8 for Australasia, and 56·9 for the Union of South Africa. Similarly, taking the percentage utilised of the total horse-power available, India is very behindhand in the development of the water power at her disposal as compared with other countries. "This was, however, only to be anticipated. A country, where the



Hydro-Electrical Installations of India.

industry has been mainly agricultural, where the labour rates are low, and the teeming millions are simple people with few wants, has not the same incentive to exploit the water power available as countries confronted with very different conditions. If India has moved slowly, there are reasons why she should have dawdled. But that does not mean that she is going to be content to loiter for ever. A spirit of enterprise is awakening, and will in time become much more awake and alive to the potentialities, and Mr. Milne's paper comes opportunely as a sign-post to point the way." In concluding a series of articles on the existing and proposed hydro-electrical installations in India, *Indian Industries and Power* recently published a map, which we reproduce above, pointing out that most of the places where hydro-electrical development has taken place in that country lie along two lines—an east-west line along the Himalayas, and a north-south line along the Western Ghats. In the illustration those installations that are in operation are marked with a dot; those under construction are marked with a cross, while those indicated with a circle are not working.

Railless Traction in Shanghai.—At the Private Exhibition Hall of the Inter-Ocean Photoplays Co., Ltd., on the 11th inst., Mr. D. McColl, engineer and manager of the Shanghai Tramways, by request of Messrs. Railless, Ltd., showed an interesting film depicting the railless service at Shanghai, and afterwards gave a description of the system. A feature of the cars is the life-guard in front of the wheels, which makes it practically impossible for anyone to sustain serious injuries. A rope net is fixed in front of the car, so that if it collides with a pedestrian he is picked up into the net, and feels nothing more than the shock. The cars wind in and out of the traffic with ease, and can be drawn to the side of the road, thus allowing passengers to alight and board the car without stepping on to the road. This advantage is found extremely useful in the case of a breakdown, as it does not impede the progress of the cars following behind. Mr. McColl, in concluding his remarks, said that he was of the opinion that any further extensions of British tramways should be on railless lines.

Royal Astronomical Society.—Meetings for the coming session have been arranged for the first and third Fridays of the month. The subjects chosen for discussion include geodesy, terrestrial magnetism, seismology, and meteorology. Fellows of the Physical Society are invited to attend.

An Electrical Hot-wire Inclinometer.—The above instrument was the subject of a paper read by Mr. J. S. G. Thomas before the Physical Society of London in June last. The instrument consists essentially of two fine platinum wires (diameter about 0·1 mm.) mounted parallel to one another in a closed chamber at a distance apart equal to about 1 mm. A constant current of from 0·4 to 1.5 ampere (according to the sensitivity desired) is maintained in the wires, which constitute two of the arms of a Wheatstone bridge arranged so that the bridge is balanced in the zero position of the inclinometer. If desired, the bridge may be constituted of two pairs of heated wires as above. The inclinometer wires, in the zero position, may be either vertical or horizontal or inclined at any angle to the horizontal. The indications of the instrument are dependent upon the relative heating or cooling effects experienced by the respective wires when the orientation of the wires about a horizontal axis is altered. The galvanometer deflection occurring with alteration in such orientation serves to indicate the inclination of a definite radius vector to the horizontal, and calibration curves were given for the cases where the axis of rotation is horizontal, and (*a*) in the plane of the wires and parallel to the wires, and (*b*) at right angles to the plane of the wires. The characteristics of the calibration curves were discussed and curves given showing how the resistances of the respective wires depended upon the orientation of the wires. Attention was directed to the finite width of the column of heated gas ascending from the wires, and an empirical formula was deduced expressing the maximum deflection as a function of the bridge current employed. In the course of the discussion on the paper, Mr. F. J. W. Whipple referred to practical applications, such as the use of the instrument in an aeroplane. How would the results be effected by angular acceleration of the system? Mr. F. E. Smith emphasised this point. It appeared that this inclinometer would give precisely the same indication as a mechanical inclinometer, such, for instance, as a suspended bob or a marble in a glass cylinder. In the two possible cases of unaccelerated flight, viz., right way up and upside down, there was never any doubt. Dr. Hopwood asked how the behaviour varied with the diameter of the wire used? Some time ago he had heated two loops of fine wire in series in coal gas. At atmospheric pressure the finer of the two glowed perceptibly and the other did not. On reducing the pressure it was possible to get the thicker wire glowing while the other was dark. Could any anomalous effects arise from such causes as this? Mr. Thomas, in reply, said that he had determined the ratio of the thermal conductivity of various gases to that of air. He had found the same ratio at 600° C. as at ordinary temperatures, and had interpreted this as indicating the existence of a skin of occluded gas round the wire. The thickness of this skin would be the *b* term in King's formula. He had not yet investigated the conditions below the wire. He agreed that the instrument only indicated the apparent direction of gravity, but he had had the impression that there was some difficulty in discriminating between right and wrong way up in certain cases, and that there was no satisfactory indicator for this purpose in use. Another application connected with aviation was in setting the nose of experimental models exactly head on to the wind. Experiments had been made with various wires, and no anomalies of the type mentioned by Dr. Hopwood were found. The gas was at atmospheric pressure in practice.

Vacuum Arcs for Interferometry.—A paper on the use of vacuum arcs for interferometry was recently read by Mr. J. Guild before the Physical Society of London, in which he discussed the relative merits of short and long mercury arcs for this work, and pointed out that the defect of the former was due to the broadening of the spectrum lines consequent on the high vapour pressure within the lamp. He showed that by attaching a condensing bulb to the lamp, so as to prevent excessive rise of vapour pressure, the short lamp could be made practically as good as the long one as regards sharpness of lines, while still being of much greater intrinsic brightness.

Canada's Domestic Electric Apparatus Industry.—The report of the Bureau of Statistics for 1918 shows that 68 undertakings manufacturing electrical apparatus were in operation, with a capital investment of over £10,000,000 and employing 8,863 people. The following quantities of material used by these industries are of interest:—Foundry castings, iron, brass, copper, and aluminium, 95,099 tons; pig-iron, 4,190 tons; steel, bar-sheet and castings, 6,287 tons; insulating materials, 6,290 tons. The total selling value of articles produced in 1918 was £7,000,000. Canada in 1919 imported electrical apparatus to the value of £2,600,000, most of which was from the United States.

Inquiry.—The name of a North of England firm, that makes chimney corner castings (four corner brackets with bolts), to which insulators are bolted for carrying overhead mains, is asked for.

Appointments Vacant.—Deputy engineer-in-chief and manager, for the Shanghai Municipal Electricity Department (salary 1,000 taels per month; tael = 5s. 6d.); director of posts and telegraphs (£600), for the Government of the Somaliland Protectorate; electrical and general draughtsman, technical instructor in electrical engineering, and chief instructor in dynamo and motor manufacture, &c., for the Government Instructional Factory, Ponders End; assistant lecturer (£300), and demonstrator in civil and mechanical engineering, and one for the Electrical Engineering and Applied Physics Department (£300), for the Northampton Polytechnic Institute; shift charge engineer (£276), for the Walsall Corporation Electricity Supply Department. See our advertisement pages to-day.

Australian Developments.—With the issue of our contemporary, the *Industrial Australian and Mining Standard*, for June 17th, 1920, there is included a special supplement of 50 odd pages describing, and very fully illustrating, the "Harnessing of Australia's Greatest River," the great scheme undertaken by the Governments of the Commonwealth of Australia and of the States of New South Wales, Victoria, and South Australia, with a view to the more profitable use of the waters of the river Murray.

Home Office Factory Inspectorate.—An important scheme of reorganisation has been sanctioned for the factory department of the Home Office, and will be brought into operation as soon as the necessary arrangements can be made. Among the alterations are the following: It has become necessary, owing to the increase in the number of factories and workshops, and the great growth in the duties devolving on the inspectorate, to reduce the areas of the divisions and districts into which the country is divided for inspection purposes. The number of divisions will be increased from six to ten, and the number of districts from 62 to 85, while a corresponding reduction will be made in the number of junior inspectors. The scientific and technical staff of the department will be considerably strengthened in order to enable it to cope with new developments with regard to safety and health. The medical staff is to be increased from three to five, one of whom will be a woman. The special engineering staff which is more particularly concerned with problems of safety, ventilation, &c., arising in connection with the administration of the Factory Acts, will be reconstituted and enlarged; and, in view of the great growth in the use of electricity for industrial purposes, four additional electrical inspectors will be appointed to enforce the safety requirements of the electricity regulations. The changes involve considerable redistribution of the staff as between the various grades, and in particular the number of women inspectors will be considerably increased, but the total number of the staff will remain about the same. At the same time, the scales of salaries of the inspectorate have been revised in view of the increase in the remuneration which technical qualifications and experience command in industry.

A New Transmission Gear.—We were recently priviledged to examine an invention for which a great future is predicted. In general, present-day variable-speed gears are not entirely satisfactory, their chief drawback residing, of course, in the process of changing from one speed to another. In all spur gears a certain amount of skill on the part of the man in charge is absolutely necessary to the well-being of the mechanism. The gate system of gears permits of certain definite ratios only, thus limiting the majority of gears to a small number of changes. To obviate these and other undesirable features in transmission and speed control the present invention, the work of Mr. Francis J. Healey, has been evolved. Mr. Healey's invention consists of two expanding and contracting sprockets mounted on parallel shafts, and connected by an endless chain of constant length. The use of expanding pulleys in this connection is probably not new, but the driving connection in previous designs of this nature has been purely frictional, and the employment of a chain drive fitting into accurately cut gear teeth is a novel departure. In the application inspected, which was a typical example of the gear applied to machine-tool operation, the sprocket device consisted of a number of segments mounted and free to operate in radial slots between two retaining plates. Each segment consisted of a block into which two or three teeth were fixed, a spring allowing a small temporary circumferential displacement to permit the teeth to adjust themselves to the chain and returning them to their normal position when past the chain. Entering the centre of the wheels and mounted upon each of the two parallel shafts were cones bearing ribs of dovetail section to coincide with and support the toothed segments. These cones were coupled together in such a manner that, by the operation of a lever, as one receded from the sprocket wheel, thereby allowing the segments to fall towards the centre and reduce the diameter, the other entered the wheel on the opposite shaft forcing its segments outwards, and thus keeping the chain at the same degree of tightness. The action throughout was very smooth and noiseless, even when the lever was quickly brought over from one limit to the other. The range of speeds extended from 1 to 9 in each direction; any intermediate fractional ratio was obtainable, the only operation necessary being the movement of the controlling lever. The cases in which this gear might be installed with advantage are innumerable, but the makers anticipate that the greatest demand will be forthcoming from makers of printing machines as well as lathe and other machine-tool manufacturers. Its application to automobiles is also contemplated. It is proposed to incorporate the gear in the lathe itself, and thus do away with the present headstock and countershaft system. As an indication of its practical and commercial worth, it may be mentioned that in the negotiations for the purchase of a works by the British Universal Variable Gears, Ltd., who have acquired the sole British rights of the invention, the vendors have signified their willingness to take the whole of the payment in shares. Furthermore, the purchase price agreed upon was not excessive, but rather in the opposite direction.

L. & N.W. Railway Electrification.—The rearrangements and improvements on the London & North-Western Railway lines between Chalk Farm and Euston, which were begun in 1913, but were interfered with at the outbreak of war, and finally closed down as a result of an order issued by the Ministry of Munitions at the end of 1917, under which the Government took possession of the contractors' plant, have recently been resumed, says the *Times*, and already considerable progress has been made. The principal object of the alterations is to provide a means whereby the electric trains which for some time past have been running from Broad Street, City, to Watford, *via* the Hampstead Junction line, should also be able to run *via* Chalk Farm, and also from Euston to Watford. When the work is completed it will be possible for passengers to travel between Watford and Euston and *vice versa* by an electrified line. The approach to a busy terminus such as Euston is naturally much congested, and the congestion has been largely increased by the necessity which has hitherto existed for trains to cross over from one side to the other, with the necessary consequence that while doing so they block two lines of rails. An important part of the new scheme of alterations is the removal of this inconvenience. The proposal is to lower both up and down slow lines to allow of the up fast line crossing over them by means of a bridge, thus avoiding any crossing on the level. Some idea of the complicated nature of the plan may be gathered from the fact that three lines are almost entirely superimposed. At Chalk Farm the railway is being widened on the north (up side) and the existing lines rearranged on the widened area. This is to provide for the construction of the additional lines which are to connect the present slow (or local) lines from Euston and the North London lines from Broad Street with the new tunnels. These tunnels are constructed almost parallel with the present steam line tunnels between Chalk Farm and Loudoun Road, from which point onward there will be two additional lines reserved for Watford electric services. Another new feature which will be of the greatest convenience and conduce greatly to efficiency of working is a new tunnel by means of which empty coaches can be brought from the carriage sheds at Willesden to Chalk Farm over the existing up slow line and can cross over underground to the departure platforms at Euston. This means that the lines on the level at the approach to the station are freed from being blocked by "empties." Elaborate arrangements have been made to interfere as little as possible with the outgoing and ingoing trains at Euston while the work is in progress. It is not expected that the scheme will be completed before 1922.

Service Notes.—Naval Telephones.—It has been decided that the rental of telephones required for official naval purposes in private residences will no longer be wholly paid for by the Admiralty. Fresh arrangements are announced in Navy orders, which take effect as from April 1st last, "and no exceptions can be permitted." This decision does not affect the telephones installed in official residences, which are regarded as part of the official equipment of such residences, and the officers concerned are not charged with the rental of the instruments. According to the *Times*, as regards private houses, in cases where an officer is in receipt of emoluments of £840 per annum or over, including war bonus, he will bear the whole of the rental, together with any surcharge. Officers with emoluments of between £450 and £840, including bonus, will be required to contribute to the extent of £1 per annum. All other salaried officers will pay a contribution of 15s. per annum. The last two classes will also pay the same proportion of surcharge as of the rental. The charges mentioned are to be revised in accordance with any alteration made in the public rates for telephones. In all cases, payment for outward calls in excess of the number covered by the minimum annual subscription is to be made by the officer concerned direct to the Post Office at his own charge. Officers and others will pay rent and surcharge direct to the Post Office in the first instance, and reclaim these, less the amount of their contribution, from the Admiralty, or from the local paymaster in the case of establishments abroad. When the transfer of a telephone is not necessitated by service reasons, its cost in normal cases is to be borne by the officer concerned.

A tablet to the memory of the 50 officers and men of the Portsmouth Division of Electrical Engineers who gave their lives for King and Country in the Great War was unveiled last week in H.M.S. *Vernon*, torpedo schoolship at Portsmouth. The tablet was presented by the electrical artificers' mess of the *Vernon*.

Lieut. A. A. Davis has resigned his commission in the Tyne Electrical Engineers, which he joined in 1916, getting his second star in August, 1918. Major A. V. Sinclair, A.M.I.E.E., late Royal Engineers, has been posted to the Welsh Divisional Engineers. He served with the Royal Engineers in the late war.

The Transport Problem in Paris.—The General Council of the Seine has now adopted the scheme for the expropriation of the surface transport undertakings, to which reference was made in a previous issue, and has fixed the redemption annuities to be paid for 30 years in francs as follows: The Omnibus Co., an annuity of 16,800,000, as compared with 17,975,000 which was claimed; the Tramways de la Seine

5,400,000, as against 6,500,000 asked for; the Tramways Sud 4,100,000 in place of 5,000,000; the Est-Parisien 3,600,000 in lieu of 4,500,000; the Tramways de la Rive Gauche 620,000, instead of 650,000, and the Nogentais tramways 2,000,000 fr., as contrasted with the demand for 2,965,000 fr. One company is stated to have refused the offer, while in the other cases the respective managers are consulting the directors of the companies concerned. The Paris municipal council, which is also interested in the scheme of amalgamation under local administrative control, has endorsed the action of the general council. All the undertakings in question are proposed to be transferred as from January 1st, 1921, to an operating company according to terms to be arranged between the general council and the representative of the new company to be constituted for working the lines. M. Mariage, manager of the Compagnie des Omnibus, has undertaken to form the new company, so that it may be assumed that the existing companies will still take an interest in the future of the services in question.

Lead Poisoning in Accumulator Works.—The Manchester City Coroner held the adjourned inquiry on August 11th into the death of Nellie Farrington (22), who was employed at Messrs. Oldham & Sons, electrical works, at Denton, as an accumulator assembler, her duty being to file off a lead portion of the accumulator to make the cells fit correctly. Deceased had worked on this particular job from February to June of this year, and in the middle of the latter month she complained of a pain at the back of the neck, and was treated by a doctor for neuritis. Later acute pains in the shoulder and left arm developed, and early in July the girl was removed to Ancoats Hospital, where she died the day following admission.

Dr. Walton, of Ancoats Hospital, who gave evidence at the preliminary inquiry early in July, repeated that when admitted to the institution the deceased was in a moribund condition, and she was suffering from paralysis of the wrists (wrist drop), a common feature of lead poisoning. He could, however, find no visible traces of lead poisoning.

Dr. Harry Heap, pathologist at Manchester University, said that on analysis of the brain of the deceased woman he found there 2.44 milligrams of lead, in the kidneys 0.57 milligram, and in the liver 11.18 milligrams. Asked what his experience was as to the amount of lead likely to be present in cases of lead poisoning, Dr. Heap said that in such cases idiosyncrasy played such a great part that it was almost impossible to state the exact amount of lead. It was well known that in females the incidence of lead poisoning was greater. His experience showed him that fatalities occurred both when smaller and larger amounts of lead were present than in this case. He did not think it could be laid down that a definite amount of lead would exert definite symptoms in anybody. Some people, he said, developed resistance—they tolerated lead more than others. He had found in a typical case of lead poisoning less lead than was found in the liver in this case.

The coroner said the case was a most important one in the interests of electrical workers, and thence the reason for the microscopic examination by the pathologist. This was a clear case of lead poisoning, and his verdict would be "Death from nephritis, caused by lead poisoning." No blame was attached to Messrs. Oldham's, who took every possible precaution, and provided all necessary requisites.

Induction Frequency Changers.—A recent issue of *Power* describes a new application of the high-speed induction motor to certain classes of machine drive which has been made possible by the development of an induction frequency changer by the General Electric Co. (U.S.A.). This device generates power at frequencies that will produce speeds of 18,000 R.P.M. or higher, and as a result high-speed induction motors can be directly applied to various types of machines, eliminating belts or gears with their disadvantages.

The frequency changer consists of a wound-rotor type induction motor, the stator of which is connected electrically to an alternating-current source of power. By rotating the machine in a direction opposite to that in which it would run as a motor, frequencies are generated in the rotor equal to that of the exciting circuit plus that due to the reversed rotation of the rotor.

Practically all the energy taken from the commercial circuit is transformed into high-frequency energy, the over-all efficiency being approximately 90 per cent. Where direct current only is available, an inverted rotary converter can be used both as a motor to drive the frequency changer and to supply the excitation for the stator. The high-frequency supplied by this device being always three-phase secures uniformity as well as economy and simplifies both the motors and the frequency changers. The most economical sets are those having driving motors directly connected to the frequency changers.

The high-speed motors used in connection with these frequency changers are constructed the same as the small standard squirrel-cage motors, having rotors of the cast-alloy type and are very compact. In the construction of the rotor the punchings are held securely in place, and the slots completely filled with cast alloy. In the stator the windings are thoroughly impregnated with moisture-proof insulating compound which acts further to prevent movement of wires and unites the end turns into a solid mass which readily dissipates the heat that is generated in the interior of the winding.

The standard motors are two-pole, and wound in two series, the first rated normally at 120 cycles 220 volts, the second at 200 cycles 110 volts, to operate at a range of from 200 to 300 cycles. The operating voltage of the motors must vary in proportion to the speed and frequency, but this change is accomplished automatically by the frequency changer. The normal slip is from 5 to 7 per cent., but where the load is such that the starting torque is the factor in determining the size of the motor, it can be increased by increasing the slip to 8 or 10 per cent., although such changes are objectionable if the motor must carry full load. Successful applications have been made with speeds ranging from 7,200 to 12,000 revolutions per minute.

Wireless Telegraphy in Argentina.—The local Press of Buenos Aires recently devoted much space to a prospectus of "Transradio: Argentine Radiotelegraphic Co., Ltd.," and according to the *Times Trade Supplement*, its keynote is struck in the very first paragraph, which states that: "The idea of forming the company took shape in Germany, backed by the following institutions which have and will give it their most hearty support: The Wireless 'Telefunken' Co., 'Overseas Wireless Traffic,' Ltd., Deutsche Bank, and the Dresdner Bank, all of Berlin. The mere mention of these names signifies for shareholders most flattering prospects. These institutions conjointly form the most powerful banking and industrial consortium in Germany, and bring to the new company technical and financial capacity of the first order." To those who followed the discoveries made during the war period relative to German commercial and financial expansion abroad, this paragraph practically tells the whole story. The formation of a powerful transmitting station in Argentina able to communicate in any weather with Nauen, Berlin, and with all other stations of the group using the "Telefunken" system, is not new, at any rate, in so far as the idea is concerned, for on more than one occasion during the war tentative efforts to establish at least a receiving station in Argentina were made by local German interests.

The initial capital has been fixed at $10,000,000 Argentine paper, of which sum $4,500,000 has been found, in ordinary shares. The Argentine public are asked to subscribe $3,000,000 in 7 per cent. preference shares, the bulk of which has already been promised, and the balance will be available for issue as and when required. Complete control thus remains in German hands, and the invariable practice of modern German industrial finance is strictly adhered to.

Reduced tariffs, primarily put at two-thirds the actual rate charged by the cable companies, plus "freedom from delay and extraneous interference"—this last advantage is insisted on again and again—are calculated to give the new concern a revenue of $1,830,000 Argentine paper per annum, and that on the assumption of a bare 5,000 words daily service, which is but a quarter of the capacity of the new station. With six steel masts 210 metres in height, and a 400-KW. transmission set, it is claimed that the station will prove one of the most powerful in the world.

The company takes over the concession for the working of a high-power wireless station granted by the National Government on March 15th, 1919; the term of the concession is 30 years, after which period all the installations become, gratuitously, the property of the State.

Commenting on the prospectus, the *Review of the River Plate* says that "All the foregoing is very interesting and sounds quite practical. It seems a pity that British 'wireless' enterprise should have left neglected so important a field as Argentina for so long. A company subsidiary to the Marconi Co. was established here nearly 15 years ago, and still exists (we believe). The thousands of persons (mainly Italian residents) who took up shares from motives of patriotism (inspired by the talented inventor of the system) have never had any return, and now we learn that the Marconi rights in Argentina (controlled by the parent company in London) have been ceded to a United States enterprise which contemplates the early erection of a high-power station at Maschwitz."

Automatic Generating Station.—We have referred to or described in our columns, on several previous occasions, automatic sub-station installations, and now the *Journal of Electricity* gives a fairly long description of a remotely-controlled hydro-electric plant. This is the Ontario plant No. 2 of the Ontario Power Co., California, situated in San Antonio Canyon.

The equipment of plant No. 2 consists of one single Pelton impulse turbine, overhung from a Westinghouse 500-K.V.A., 50-cycle generator, with direct connected exciter. The turbine is rated at 550-H.P., 290-ft. head, and receives water through a duplex needle nozzle. A third separate nozzle is used as a by-pass around the unit in order to permit uninterrupted flow to plant No. 1, in case the upper plant is shut down. All three of the nozzles are operated by electric motors provided with interlocking limit switches, in order to maintain fixed relative action between the three. This arrangement is made for the purpose of maintaining maximum efficiency at all degrees of load and water consumption. Governor operated jet deflectors are also provided for emergency control and speed regulation.

Plant No. 2 is completely controlled from plant No. 1,

situated three and one-half miles down the canyon, by means of a double throw switch. The adjustable contact limit switches in the mechanism of the remotely-controlled plant are responsible for the operation of the motors, but do not themselves directly affect the operation of the motors. The contact switches act on relays and contactors on the switchboard panel, and these in turn cause the motors to operate. The various operations occur in proper sequence in the following order:—

When the plant is operating on full load, both power nozzles are full open, and the by-pass nozzle is closed. If it is desired to reject all of the load, the duplex switch in plant No. 1 is thrown to the "to close" position, and the first action is to close the relay which starts the closing of the upper power nozzle. After a certain predetermined interval a contact switch on the upper nozzle acts to close a relay, which starts the closing of the lower power nozzle. Then for a certain interval both nozzles are closing together. On reaching a certain point of closing, which corresponds to a predetermined minimum stream flow, a contact switch on the lower nozzle acts to close a relay, which effects the opening of the by-pass nozzle. Then for a short interval both power nozzles are closing and the by-pass nozzle is opening.

The upper nozzle, which starts to close first, reaches the full closed position first, and its limit switch acts to open its closing relay to prevent jamming of the mechanism. By the time the lower power nozzle reaches its full closed position the by-pass nozzle is opened to the predetermined point which discharges the required flow, and the limit switch on the lower power nozzle acts to open all relays and stop all action. Water then flows through the by-pass only, and the generator is unloaded and removed from the line.

When it is desired to put the plant on to the line, the duplex switch in plant No. 1 is thrown to the "to open" position and the sequence of operations is started, but in the reverse order, thus:—

1. By-pass closes and lower power nozzle opens.
2. Upper power nozzle opens with by-pass still closing, and lower power nozzle opening.
3. By-pass nozzle reaches full closed position with both power nozzles still opening.
4. Lower power nozzle reaches full open position and its limit switch acts to stop all action, both power nozzles being open and the by-pass nozzle closed.

The operation of the plant is not limited only to the full on or off positions, as any position between may be reached and held by the manipulation of the central switch in plant No. 1. This is a necessary provision to permit the synchronising of plant No. 2 with plant No. 1, and to regulate for different loads or stream flows.

Synchronising is accomplished altogether by the remote control of the power nozzles, the synchroscope and main generator switch being on the panel with the nozzle control switch in plant No. 1. A Tirrill regulator is installed at the upper plant to effect voltage regulation of the remotely-controlled unit in the normal way through the exciter field.

Telegraphic Photography.—By a process invented by Mr. E. Belin, a French engineer, a photograph of Swedish women athletes marching in the Olympic Games Stadium at Antwerp was "telephoned" 200 miles from Antwerp to Paris last week in eight minutes, and appeared in the *Matin*. According to the *Times*, the invention makes use of the inequalities of the surface of a carbon photograph. The inequalities, which are exceedingly minute, vary with the depth of shadow—that is to say, with the effect of the light upon the surface of the medium. The method of utilising these conditions is as follows: The photograph to be transmitted is placed on a cylinder in every respect like the cylinder used in phonography, which, as it revolves, presents to a needle every point of its surface. The needle and cylinder form part of a telephone circuit, and the sound of the needle as it passes over the diminutive elevations and depressions of the photograph are amplified by means of a microphone attached to the needle, that is to say, current which passes through the telephone wire varies in conformity with the inequalities of the surface of the photograph. It remains only to translate at the receiving end these variations of the current in such a fashion as to reconstitute the picture. This is done by means of a Blondel oscillograph.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Mr. H. B. CLARKE, A.M.I.E.E., on resigning the position of chief assistant engineer to Messrs. Boots Pure Drug Co., Ltd., to take up that of engineer to Messrs. British Glues and Chemicals, Ltd., Kingsway, was presented with travelling requisites by Mr. C. H. Jessop, A.M.I.E.E., chief engineer, on behalf of the members of the department and friends.

The *Commonwealth Engineer* states that Mr. H. W. CLAPP, vice-president of the St. Louis Railway Co. (U.S.A.), who has been appointed chairman of the Victorian Railway Commissioners, is about to take up his duties. He was educated in Melbourne, and later served his apprenticeship as an engineer with the Otis Engineering Co. From Melbourne, he went to Queensland as an electrical engineer in the Brisbane Tramway Co. He relinquished this position to acquire additional technical training in the United States, and for several years he was with the General Electric Co. of U.S.A. Later he took up a position with the Atlantic, Camden, and New Jersey Railroad Co., and afterwards was employed as an electrical engineer by the Southern Pacific Railroad Co.

Mr. E. G. FOSTER, electrical engineer and tramways manager to the Invercargill Borough Council, N.Z., has resigned his position to join the firm of Carrick, Wedderspoon & Co., electrical merchants, Christchurch. The Council has promoted Mr. A. C. Carman to the position of borough electrical engineer, and Mr. B. J. Glancefield to the position of tramways traffic manager.—*Commonwealth Engineer.*

Sir LOMER GOUIN has been elected a director of the Shawinigan Water & Power Co., Quebec, and it is understood he is to be one of the first directors of the British Empire Steel Corporation.—*Times.*

Mr. T. G. WILSON, late electrical engineer to the Hamilton (N.Z.) Borough Council, has been appointed by the Timaru Borough Council from among 32 applicants, electrical engineer for that town.

According to an Auckland newspaper report, Mr. A. W. RODGER, chairman of the Invercargill Electric Power Board, has been presented with an address and a draft for £2,000 in recognition of his services to the province as chairman of the Southland League and Electrification Committee, which carried out the preliminary work in connection with the provincial electrical scheme.

The King has awarded the silver medal for gallantry in saving life at sea to Mr. G. H. FLAVEL, chief officer of the Post Office cable ship *Alert*. The *Times* states that in February last, while the *Alert* was engaged in operations for the repair of the Abbots Cliff-Grisnez No. 2 cable, a mine was brought up to the bows of the vessel entangled in the cable. Mr. Flavel took on himself the work of releasing the mine. He was accordingly lowered in a boatswain's chair over the bows, and released it by cutting the wires with which it had been entangled. By his prompt and courageous action he probably averted a serious disaster, involving considerable loss of life.

On his marriage, Mr. T. A. KINGHAM, borough electrical engineer at Kingston-on-Thames, has been presented by the staff with a drawing-room clock.

St. Helens T.C. is recommended to increase the salary of the electrical engineer to £800 a year, and that of the tramways manager to £650.

Mr. H. W. WATT, meter inspector in the Birkenhead Corporation electricity department, having resigned, Mr. R. Shallcross, formerly employed in the same department, but who has been away some years on war service, has been appointed his successor.

Mr. B. R. BARCLAY, A.C.I.S., has resigned his position with the Buenos Aires Great Southern Railway Co., Ltd., upon his appointment as secretary to Automatic & Electric Furnaces, Ltd.

Mr. WILLIAM LEMMON, departmental manager for Messrs. Reyrolle & Co., electrical engineers, of Hebburn-on-Tyne, is shortly to leave the district for Australia, where he will be the firm's representative. Mr. Lemmon has been with the firm 19 years. He is going at first to supervise the erection of an installation of switchgear at Melbourne, and, later, he will proceed to Sydney for a similar purpose. At a gathering at the County Hotel, Hebburn, at which Mr. W. Harriman presided, Mr. A. E. Nichol presented a silver tea service to Mr. and Mrs. Lemmon on behalf of the staff and workers.

Obituary.—MR. F. J. SATCHWELL.—The death has taken place, at Aylesbury, of Mr. F. J. Satchwell, who was formerly engaged with Sir Joseph Wilson Swan, Clarke, Chapman and Parsons, Gateshead-on-Tyne, and Sir Hiram Maxim.

SIR J. NORMAN LOCKYER.—We regret to record the death of Sir John Norman Lockyer, F.R.S., the famous astronomer, which occurred in his 85th year, at Sidmouth, on Monday afternoon. Our esteemed contemporary *Nature* was founded by him in 1869, and in the same year he was elected F.R.S. He was president of the British Association in 1903-4, and of the British Science Guild in 1912.

MR. P. E. HART.—We regret to note from the *Times* "Deaths" column that Mr. Philip Ewing Hart, M.C., chief electrical engineer to the Burma Mines, Ltd., passed away at Namtu, North Shan States, Burma, on August 10th, at the age of 42 years.

NEW COMPANIES REGISTERED.

Electro-Ferrous Engineering Co., Ltd. (169,546).—Private company. Registered August 10th. Capital, £10,000 in £1 shares. To carry on the business of iron, steel, and non-ferrous metal smelters, refiners, and founders, mechanical, chemical, electrical, and marine engineers, manufacturers of agricultural implements, tube makers, motor engine or vehicle manufacturers, &c., and to adopt an agreement with B. H. Thomas and D. S. Kennedy. The first directors are: D. S. Kennedy, Bar Close Barn, Kenley Road, Caversham; B. H. Thomas, Uplands, Haslemere; E. A. Rose, 16, Pembridge Place, W.; H. Niblett, Gorse Cottage, Hook Common, Hants.; D. J. Smith, 40, Woodberry Grove, Finsbury Park, N. Solicitor: H. F. Galpin, junr., 4, George Street, Oxford.

Percy Dove, Ltd. (169,554).—Private company. Registered August 10th. Capital, £600 in £1 shares. To take over the business of an electrical and mechanical engineer carried on by P. Dove, at 15, Greenhill Street, Stratford-on-Avon. The first directors are: P. Dove, 21, West Street, Stratford-on-Avon; A. Kendrick, 7, Albany Road, Stratford-on-Avon; A. Mole, Loxley, Warwick. Registered office: 15, Greenhill Street, Stratford-on-Avon.

Thor Electric Safety Lamp Co., Ltd. (169,558).—Private company. Registered August 10th. Capital, £25,000 in £1 shares. To adopt an agreement with Haslam & Stretton, Ltd., to develop the business referred to therein; including the trade mark "Thor Electric Safety Lamp," to carry on the business of manufacturers, importers, and exporters of and dealers in electric, oil, or other lamps, &c. The subscribers (each with one share) are: E. Mellor, White House, Kings Norton, solicitor; G. H. Nash, 913, Stratford Road, Birmingham, clerk. The first directors are to be appointed by the subscribers. Solicitor: S. Hosgood, 10, Newhall Street, Birmingham.

Ferrous Light Castings, Ltd. (169,600).—Private company. Registered August 12th. Capital, £40,000 in £1 shares (30,000 "A" and 10,000 "B.") To carry on the business of manufacturers of fine castings for the electrical trade, founders, moulders, manufacturers of iron and steel castings and castings of ferrous and non-ferrous alloys, importers and exporters of raw, partly manufactured and partly finished castings, &c., in the United Kingdom, British Dominions and foreign countries. The first directors are: P. S. Brook, 13, Curzon Park, Chester; J. A. Hirst, Donacloney, Deganwy, North Wales (both directors of Brook, Hirst & Co., Ltd.); E. N. Humphreys, Caerycael, Hoole Road, Chester (director, East Halkyn Mining Co., Ltd.); J. E. Grace, Glenside, Thelwell, New Road, Grappenhall, Warrington. Registered office: The Foundry, Stafford Road, Wilderspool, Warrington.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Sevenoaks & District Electricity Co., Ltd.—Particulars of £20,000 debentures authorised June 15th, 1920, whole amount issued, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees.

Splitdorf Electrical Co. of London, Ltd.—Satisfaction in full on July 31st, 1920, of debentures dated October 9th, 1919, securing £5,000.

Steel Wing Co., Ltd. (formerly Krieger Electric Carriage Syndicate, Ltd.).—Mortgage dated July 29th, 1920, to secure all moneys due or to become due from company to National Bank, Ltd., charged on certain moneys and company's undertaking and other assets, including uncalled capital.

Harry W. Cox & Co., Ltd. (in liquidation).—Satisfaction in full on July 1st, 1920, of debentures dated December 10th, 1912, June 28th, 1916, and January 22nd and March 27th, 1919, securing in all £6,950.

Pontelec Welding Patents, Ltd.—H. S. Brown, of 8, Newhall Street, Birmingham, as receiver and manager by Order of Court, dated July 15th, 1920.

Bridgwater & District Electric Supply & Traction Co., Ltd. (75,429).—Capital, £20,000 in 15,000 ordinary and 5,000 preference shares of £1 each. Return dated July 10th, 1920. 12,899 ordinary and 2,657 preference taken up. £6,674 paid on 4,017 ordinary and 2,657 preference. £8,882 considered as paid on the remainder. Mortgages and charges £12,850.

Bournemouth & Poole Electricity Supply Co., Ltd. (55,189).—Capital, £500,000 in 25,000 ordinary, 7,500 4½ per cent. preference, and 17,500 6 per cent. second preference shares of £10 each. Return dated March 25th, 1920. 15,000 ordinary, 7,500 preference, and 17,500 second preference taken up. £400,000 paid. Mortgages and charges £187,500.

CITY NOTES.

Tyneside Tramways and Tramroads Co.

For the half-year ended June, 1920, the surplus of receipts over expenses was £2,667, plus £2,237 brought forward. After meeting interest charges, the available balance is £3,459, and after adding £3,000 transferred from special reserve, 5 per cent. per annum, less income tax, is paid on both the preference and the ordinary shares, £1,500 is put to reserve for renewals, &c., and £1,011 is carried forward. The traffic receipts increased by £4,528, but the running costs exceeded that amount. Under the Bill which had received the Royal Assent, the company was empowered to charge fares which would enable it to meet the large increase in operating costs.

At the half-yearly meeting on August 10th, Dr. J. T. Merz said that while there was an increase of £4,500 in the traffic, the expenses had increased by over £8,000, and to meet this they had to draw upon the permanent reserve to the extent of £3,000, as against £1,500 last year. The reserve fund stood at £40,900 odd, though they must understand that that amount was not really available. They had only available £29,000, for they had used up a very large amount of reserve for capital purposes, and it was the object on the present occasion to take the necessary steps to bring up the capital investment reserve fund to the higher figure. This they could do by issuing the amount of loan capital they were entitled to offer. They must have that money where it could be got at if the necessity arose, either in investments which could be realised, or in loans that could be drawn at a short notice. In addition they had spent on capital account for car-sheds and three new cars £8,302. As to the issue of new bonds they could make in the near future, it was only for a small sum—£12,500—which was hardly enough for their purpose. The bonds would bear interest at the rate of 5½ per cent., free of income taax. As for their Bill, by it they had really obtained what they wanted. The three points they asked for were: first, the right to increase their fares, which were being advanced, roughly, from 1d. to 1½d.; secondly, they had the right to issue loan capital bonds in proportion to the share capital subscribed; and, thirdly, the right to run motor omnibuses.

Vera Cruz Electric Light, Power and Traction Co., Ltd.

In his address at the annual meeting, on August 11th, Mr. V. W. Yorke said that during 1919 the revenue from both sections of the company's business showed an improvement. In the light and power section the gross revenue showed an increase of approximately 10 per cent., and in the tramway section over 4 per cent., and while operating expenses as a whole remained very much the same as in 1918 the combined net revenue showed an increase for the year of approximately 17 per cent. Exchange account again showed a profit. Excess profits duty had this year been increased and a new burden in the form of a corporation tax had been imposed. So far the company had incurred no liability for excess profits duty, for the reason that it had several lean years during the Mexican Revolution, and spread over the whole period of the tax the assessable profits had been offset by the lean years when the profits were considerably less than the pre-war standard. Although conditions in Mexico could not be considered settled, they had every reason to believe that the part of that country which they served was again occupied in its normal pursuits. The history of the past few years had proved that in times of revolution public utility companies were allowed to carry on their business with little or no molestation, and their properties were on the whole respected. This company, largely because of the skill and tact of the management, had been particularly fortunate in this respect. In recognition of the valuable services rendered by Mr. Worswick, who had been general manager of the company since its formation, it was the intention of the board to elect him managing director. The extension of the tramways to Balneario, a sea-bathing resort, had proved a valuable asset to the company, and the board had recently authorised the purchase of additional shares in the company which owned this establishment. This would give the company a controlling interest and would enable the Balneario Co. to complete work already in hand, and to erect a dancing pavilion for the working-class population. This additional attraction should materially add to the revenue derived from this section of the tramways. The company continued to receive its power from the Tuxpango plant of the Puebla Tramway, Light & Power Co., and during the year under review practically a continuous service was provided by that company. During the few interruptions which were of short duration, their own plant had carried the load, but as this plant, which consisted of six Diesel engines, was now very old, the board was considering the advisability of installing a new steam turbo unit of some 2,500 H.P. as a stand-by in case of need. In that event, the existing plant would be disposed of at the best price obtainable. For the first five months of the current year the net earnings in Mexico were somewhat lower than in 1919, owing to increased labour charges, and the fact that there had recently been an outbreak of plague in Vera Cruz. Places of amusement were again open to the public. The prosperity of this company, as well as that of any other company whose earnings were collectible in Mexican currency, must necessarily depend on the exchange value of such currency. This was a danger they always had to face, but so long as gold and silver continued to be the basis of the currency in Mexico, they had every reason to believe that the earnings would continue to improve, and he hoped that it might be possible to maintain the dividend at the present rate.

A Dutch Company.—The report for 1919-20 of the Hengelosche Electrischeen Mechanische Apparaten Fabrik, of Hengelo, records net profits of 782,000 florins, as compared with 434,000 florins in the previous year, and a dividend at the rate of 10 per cent. has been declared, as against 8 per cent. in 1918-19. The directors state that all departments are now amply provided with orders, and those received in the first half of 1920 are four times greater than in the corresponding period of 1919. In addition the company has opened up markets outside Holland.

France.—Despite the difficulties of the period the Société d'Eclairage, Chauffage et Force Motrice made a gross profit of 9,462,676 fr. in 1919, compared with 9,255,318 fr. in the previous 12 months. Net profits amounted to 4,915,555 fr., as against 5,565,557 fr. The dividend is maintained at 4 per cent., or 10 fr. per share.—*Reuter's Trade Service* (Paris).

Clyde Valley Electrical Power Co.—Interim dividend of 2½ per cent., less tax, on ordinary for half year.

Stock Exchange Notices.—Application has been made to the Committee to allow the following to be officially quoted:—

Pinchin, Johnson & Co., Ltd.—247,992 ordinary shares of £1 each, Nos. 1 to 247,992, and 500,000 6½ per cent. cumulative preference shares of £1 each, Nos. 1 to 500,000.

Dealings in the following have been specially allowed by the Committee under temporary regulation 4 (3):—

Bournemouth & Poole Electricity Supply Co.—£150,000 7½ per cent. seven-year notes (registered), Nos. A1 to A20 (£5), B1 to B40 (£10), C1 to C40 (£25), D1 to D100 (£50), E1 to E700 (£100), F1 to F147 (£500).

The Committee has ordered the following to be officially quoted:—

General Electric Co., Ltd.—1,600,000 7½ per cent. "B" cumulative preference shares of £1 each, fully paid (Nos. 1 to 1,600,000).

Newcastle-upon-Tyne Electric Supply Co., Ltd.—5,215 5 per cent. preference (non-cumulative) shares of £1 each, fully paid (Nos. 1,354,287 to 1,359,501); 1,500,000 7 per cent. cumulative preference shares of £1 each, fully paid (Nos. 1 to 1,500,000).

Spain.—The net profit realised by the Electra Industrial Espanola during the past financial year amounted to 507,555 pesetas, gross earnings being 813,752 pesetas and working expenses 306,197 pesetas. The dividend is 10 per cent., or 50 pesetas per share.—*Reuter's Trade Service* (Madrid).

South Metropolitan Electric Light & Power Co., Ltd.—Dividends on the 7 per cent. cumulative first preference shares and the 6 per cent. cumulative second preference for the June half-year.

Aberdeen Suburban Tramways Co., Ltd.—Profit for the year ended July £1,262, plus £5,719 brought forward. £1,000 to renewal and depreciation; 7 per cent. dividend; carried forward £2,432.

British Columbia Electric Railway Co., Ltd.—Dividends of 3½ per cent. on preferred and deferred ordinary stocks, free of tax.

Waste Heat and Gas Electrical Generating Stations, Ltd.—Interim dividend of 2½ per cent., less income tax, for the half-year ended July 31st, 1920.

STOCKS AND SHARES.

Tuesday Evening.

Foreign politics, money and August are the three predominant factors in Stock Exchange markets. It is no bad thing, in one way, that the Russo-Polish entanglements should have arrived—if they had to come—during the slackest season of the year, when Stock Exchange business would have been idle in any event. And it is singular to notice how little the markets are influenced by the near approach of dearer money. Recognised as a handicap, an 8 per cent. Bank Rate is contemplated without nervousness, and the prospect which would have aroused undisguised anxiety a year ago is now faced with equanimity.

The declines in manufacturing shares, General Electrics, Edisons, Electric Constructions, British Aluminiums, Siemens, Callenders, and the like, are largely the reflex of monetary conditions. Banks decline the facilities obtainable in the past, and, accordingly, money for extensions, &c., has to be obtained from the public. Issues of ordinary shares are none too popular, owing to the possible influence of E.P.D. and other taxes. The investor asks for something more certain and secure, in days when Stock Exchange speculation is dormant. Therefore, such rates as 7½ and 8 per cent. are offered, by good concerns, on preference shares, and this automatically raises the yield per cent. which the buyer of ordinary shares expects to get. It is not only from mining issues that the speculative investor demands 10 per cent. on his money. Industrials, too, must return that rate in these days, and so it happens that in lists such as ours, the level of prices has a tendency to droop towards the basis of double-figure yields.

It may be reasonably argued that the ever-rising costs of living and the diminishing spending value of money must have the logical effect of increasing the value of such assets as power-stations, machinery, plant, &c. The intrinsic security of shares, backed by assets like these, should therefore be growing all the time that costs advance. There are, however, obvious flaws in this contention, and the investor asks whether to-day's values, upon the security of which he is invited to lay out his money, may not prove temporary and artificial. Whether, in short, his old-fashioned ideas of security are not in some danger of being lost altogether as one result of the war.

Turning to the practical side of the business, prices are not much changed in the various electricity sections. Several of the new issues in the cable group are a little lower, although the senior stocks hold their ground. New Western Telegraphs are 5½, Eastern Extensions 5½, and Globes the same price—all these being £2 paid. Eastern Telegraph new shares are quoted about 12s., and the fully paid at 1½. Marconis are 5s. higher at 3. The muddle over starting a market in Radio Corporations is not yet disentangled. It is quite possible that there may be further delay ranging from four to eight weeks before dealings begin in this country. In New York, the prices work out to about 22s. 6d. for deferred, preferred and "assets certificates" combined.

Electricity Supply shares are being quoted ex their interim dividends, and the effect is to make the yields look more handsome than ever. Coal and labour uncertainties are declared in the Stock Exchange market to be the two main reasons that keep investors away from this department. One or two of the leading London companies are said to be thinking of new issues, but the conditions of the money market are not encouraging.

Home Railway stocks display rather more resistance to their long depression; the electrical issues have not moved at present, although the steam descriptions are distinctly better. Other traction varieties keep tolerably hard, and the disposition in regard to Mexico is more cheerful. The British Columbia Electric Railway deferred and preferred stocks are now ex the dividends of 3½ per cent., free of tax.

In the rubber share market, there is next to nothing going on. Iron, steel and kindred descriptions are inclined to give way. The armament market is irregular, with changes narrow and Vickers the firmest spot. The Notes recently offered by Vickers are good at 1½ premium, and Armstrong second debenture is dullish at 2½ discount. The new Calcutta debenture is being quietly absorbed at about 1½ discount.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Aug. 17, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	6¾	—	£1 8 2
Charing Cross Ordinary	4	7	9½xd	—	10 15 6
do. do. do 4½ Pref.	4½	4½	9½xd	—	8 8 8
Chelsea	3	4	5½	—	8 0 0
City of London	8	10	11	—	8 17 10
do. do. 6 per cent. Pref.	6	6	17/6	—	6 17 2
County of London	7	8	9	—	10 0 0
do do. 6 per cent. Pref.	6	6	8½	—	7 8 8
Kensington Ordinary	6	7	9½xd	—	9 6 6
London Electric	Nil	2½	1½	—	6 0 0
do. do. 6 per cent. Pref.	6	6	9	—	10 0 0
Metropolitan	5	6	9½xd	—	10 8 8
do. 4½ per cent. Pref.	4½	4½	5½	—	8 0 0
St. James' and Pall Mall	10	12	6½	—	9 1 2
South London	5	6	9½	—	9 12 0
South Metropolitan Pref.	7	7	10/0	—	7 0 0
Westminster Ordinary	8	10	6	— ½	10 0 0
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	79½	—	7 11 0
do. Def.	20/6	1½	17½	—	8 11 6
Chile Telephone	8	6	6	—	*5 0 0
Cuba Sub. Ord.	7	7	8½	—	*8 4 8
Eastern Extension	8	10	14½	—	*8 15 7
Eastern Tel. Ord.	8	10	150	—	*8 13 4
Globe Tel. and T. Ord.	8	10	15	—	*8 12 4
do. do. Pref.	6	6	·5½	—	7 1 2
Great Northern Tel.	22	22	21½	—	10 4 8
Indo-European	13	10	80	—	8 6 8
Marconi	25	25	3	+ ½	8 6 8
Oriental Telephone Ord.	10	12	9½	—	*4 16 0
United R. Plate Tel.	8	8	6½	—	*5 15 6
West India and Panama	1/3	Nil	½	—	Nil
Western Telegraph	8	10	15	—	*6 13 4
Home Rails.					
Central London Ord. Assented	4	4	44½	—	8 19 9
Metropolitan	1	1½	19½xd	—	6 8 2
do. District	Nil	Nil	15	—	Nil
Underground Electric Ordinary	Nil	Nil	1½	—	Nil
do. do. "A"	Nil	Nil	5/6	—	Nil
do. do. Income	5	4	57½	—	—
Foreign Trams, &c.					
Anglo-Arg. Trams. First Pref.	Nil	5½	9½	—	8 9 2
do. 2nd Pref.	Nil	Nil	5½	—	Nil
do. do. 5 Deb.	5	5	58½	—	8 11 0
Brazil Tractions	Nil	Nil	4½	— ½	Nil
Bombay Electric Pref.	6	6	19½	— ½	4 10 0
British Columbia Elec. Ry. Pfce.	5	5	54½	—	9 3 6
do. do. Preferrred	3½	6	40½xd	—	*7 1 0
do. do. Deferred	Nil	3	40.xd	—	*8 19 0
do. do. Deb.	4½	4½	65	—	7 14 7
Mexico Trams 5 per cent. Bonds	Nil	Nil	30	—	Nil
do. 6 per cent. Bonds	Nil	Nil	31	—	Nil
Mexican Light Common	Nil	Nil	14	—	Nil
do. Pref.	Nil	Nil	25½	—	Nil
do. 1st Bonds	Nil	Nil	20	—	Nil
Manufacturing Companies.					
Babcock & Wilcox	15	15	2½	—	*6 0 0
British Aluminium Ord.	10	10	1	—	10 0 0
British Insulated Ord.	12½	15	11½	—	8 5 6
Callenders	25	15	1½	— ½	11 8 6
,, 6½ Pref.	6½	6½	18/-	—	7 4 5
Casimer-Kellner	20	17	8	—	8 18 4
Crompton Ord.	10	10	19/6	—	10 5 2
Edison-Swan, "A"	10	10	1½	—	8 17 10
do. do. 5 per cent. Deb.	5	5	78½	—	6 5 2
Electric Construction	10	10	1	—	10 10 4
Gen. Elec. Pref.	6½	6½	18/6	—	7 0 5
do. Ord.	10	10	1½	—1/9	*7 2 10
Henley	25	15	1½	—	8 0 0
do. 4½ Pref.	4½	4½	8½	—	6 12 6
India-Rubber	10	10	25/9	—	*7 15 4
Met.-Vickers Pref.	—	8	2½	—	7 6 2
Siemens Ord.	10	10	25/-	—	*8 0 0
Telegraph Con.	20	20	10½	—	*5 17 0

* Dividends paid free of Income Tax.

LIGHT—ITS USE AND ABUSE.

In the days when there was a less general appreciation than exists to-day of the fundamentals of good publicity, there was apparent a marked tendency to buy space by the square inch, as it were, and without a proper understanding of the principles underlying the effective *use* of the space which had been bought. The next stage in the development of publicity seems to have consisted in a realisation of the fact that amongst the primary requirements of an advertisement was the power to attract attention. Success, however, demanded a somewhat closer study of the psychological truths involved in advertising than was betokened by a mere appreciation of the value of size and power of attraction. Even to-day, we are all well acquainted with the advertisement which is of ample size and which often, by the use of crude and ugly devices, compels our attention, yet fails utterly to awaken in us either a desire for the advertiser's goods or the intention to gratify it. The science of publicity has, of course, travelled many leagues since advertisements of this character were the rule, with the result that the high-class publicity of to-day not only attracts our attention without the use of any "stunts," but succeeds in holding our interest while we are being impressed with the desirability of the article advertised.

Such a digression from the subject of this article would be unwarranted were it not that the development of illuminating engineering has followed so similar a path, and that lighting, moreover, so often serves as a publicity medium in addition to its main purpose. The principles of good lighting have, of course, been reduced to almost exact dimensions, and the knowledge which we have at our disposal is such as to enable us to make the most effective use of those sources of light which are at present known to us. Coincident, however, with such an exact knowledge of the subject as exists in illuminating engineering circles, we have in our houses, streets and shops, some of the most ghastly examples of bad and even vicious lighting, of which it is possible to conceive.

One explanation of this is no doubt to be found in the comparative closeness with which new sources of light have followed one upon the heels of the other, each necessitating some modification in the practice, if not in the principles, of illumination. Unfortunately, there has been a noticeable "lag" between the adoption of each new light source by the public and an appreciation of the new methods of lighting which it has entailed. In part, therefore, bad lighting evidences itself to-day as a failure to suitably screen light sources of high intrinsic brilliancy. On the other hand, some of the most glaring examples of poor lighting, in shop windows and the like, are doubtless due to a desire to crowd the maximum amount of light into the available space, quite regardless of the real lighting requirements of the situation. One of the worst exhibitions of this form of over-illumination was to be seen in pre-war days outside the shops of one of the big tobacconists of the Metropolis, some three big arc lamps being crowded along a frontage of about 12 ft. These lights did not serve to illuminate the goods in the window in the slightest, and much the same result might have been obtained by means of a steam whistle or a continuously-operating Klaxon horn.

Fortunately the public has a legal remedy in the case of objectionable and distressing noises, but with the removal of wartime restrictions, misguided lighting enthusiasts show signs of renewing their activities without let or hindrance, and with greatly increased opportunities by reason of the half-watt lamp. In the days of gas lighting (it is almost safe to speak of those times in the past tense) there was comparatively little opportunity for the concentration of high-power light sources. With the coming of the arc lamp the scramble for excessive illumination commenced, and to-day the half-watt lamp not only enables over-illumination to be indulged in at a moderate cost, but also presents the problem of an illuminant of high intrinsic brilliancy which is widely used without any form of shade or screen. This, of course, is not intended as an adverse criticism of the half-watt lamp, which, on the contrary, is proving an inestimable boon to the community. Like all good things, however, it is capable of abuse, and it is being badly abused to-day. Walk down any shopping thoroughfare, except perhaps in the most fashionable quarters, and note not only the number of exposed half-watt lamps, but also the frequent examples of excessive illumination, presumably with a view to attracting attention.

The disadvantage of such forms of lighting even to the user should be sufficiently obvious. In the case of shop lighting, a glance at a few shops from the top of a tramcar or omnibus is a sufficient proof of the fallacy of indulging in over-illumination as an advertisement. Where the principles of good lighting are followed out the display is thoroughly illuminated without having any lamps in the direct line of vision or any unnecessary waste of light upon the pavement outside, and it will be noticed that it is the window which is lighted in this manner which, even from a distance, stands out from the rest. The cynic will suggest that it is by reason of its rarity, but actually it is on account of the contrast which it offers to the comparative darkness of the street, in much the same way as the stage of a theatre shows up against the darkness of the rest of the building. Where unscreened lights inside the window, or excessive external lighting are indulged in, however, the result is merely a "light-screen" between the observers and the displayed goods, which latter, from a short distance, are very effectively obscured.

The wider and more important effects of bad lighting upon the eyesight are, unfortunately, insufficiently realised, and it is rapidly becoming necessary that steps shall be taken to guard against the extended use of injurious methods of illumination. In the case of objectionable sounds, there is, as has been previously indicated, a legal remedy, and the use of freak noises by motor vehicles has long been forbidden, although in neither of these cases is there any permanent damage to the auditory nerves. The results of continued bad lighting, however, very soon evidence themselves as permanently impaired vision. In certain cases, too, such, for instance, as the dazzling effects of high-power motor headlights, there is immediate danger from the temporary blindness which results to pedestrians and the drivers of other vehicles. Were it possible, however, to institute legal proceedings in individual instances, it is open to doubt whether the desired result would be obtained. The only method of ensuring a permanent alteration would appear to be by the education of the public to the point where it will appreciate the virtues of god lighting and shun the results of bad.

The question how this process of education is to be carried out, is bound ere long to become a problem of some importance. Much, of course, might be done by means of a Press campaign, but the question arises, who will be willing to finance such a movement? With the rapid extinction of gas lighting, the matter becomes primarily the concern of the electrical industry, but the electrical bodies which might interest themselves in the subject are already using part of their financial resources to counter the work of the British Commercial Gas Association. As far as manufacturers are concerned, those firms which have specialised in lighting and have spent an immense amount of time in the development of efficient methods, do not, unfortunately, come into direct touch with the users.

There remains the electrical contractor who is in daily contact with consumers, and one is driven to the

conclusion that he is the only person who is in a position to exercise a decisive influence in the direction of improved illumination. That a steady and systematic campaign by contractors in favour of better lighting would eventually achieve the desired object can hardly be doubted. That it would result in a considerable accession of business to the contractor is not less certain, while the user would himself be benefitted by an improved illumination, probably at a lower cost. That contractors are not, as a body, lighting specialists is perhaps true, but since a closer study of the subject would be of such inestimable benefit to everyone concerned, and not least to themselves, it seems reasonable to suggest that they should include a specialised knowledge of illuminating engineering amongst their qualifications. That they will eventually need to do so is hardly in question, and since the need for better lighting is so clamant an early movement in the direction indicated would appear desirable.

EXTRA LONG-DISTANCE TRANSMISSION OF ELECTRICAL ENERGY.

Principles and Applications of the Quarter-Wave and Half-Wave Systems.

(*Continued from page* 220).

Intermediate Tappings Impracticable.—All of these considerations are reassuring regarding security of operation of a quarter-wave system, but there is one serious limitation which is inherent to the system, viz., that the pressure along the lines varies with the load at the end of the latter, hence it is impracticable to take energy from the line at intermediate points. The system is, therefore, restricted to the transmission of energy in bulk from one point to another.

Effect of Harmonics.—When a condenser and a reactance coil are connected in series and supplied at frequency $f = \omega/2\pi$, there is resonance when $LC\omega^2 = 1$. Similarly, if the inductance and capacity are distributed, as in a transmission line, there is a frequency f giving resonance in a quarter-wave line. This frequency is $F = 1/[4\,l\,\sqrt{(L_1 C_1)}]$; l being the length of the line, and L_1, C_1 the self-inductance and capacity per unit length. Unlike the case of separate capacities and inductances, this is not the only frequency producing resonance.

The quarter-wave line, such that an impulse travels from one end to the other in the time representing one-quarter of a period of frequency f, may be likened to a closed sound tube. In the latter when an impulse is produced at one end, the whole mass of the enclosed air enters into vibration and produces a sound of frequency f. One end of the tube is at a loop or maximum of vibration, and the other at a node. Such a tube may, however, vibrate for all the odd harmonics $3f$, $5f$, &c., with the formation of intermediate loops and nodes. In the same way, the quarter-wave line gives

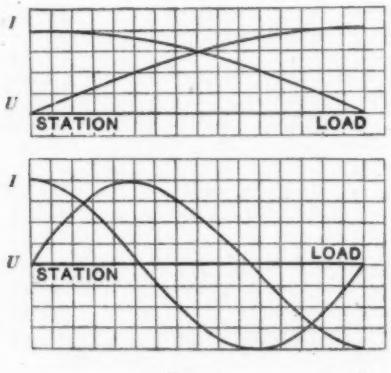


Fig. 1.

reciprocal transformation, from constant current to constant potential, and *vice versa*, for all odd harmonics, which are, therefore, transmitted under the same conditions as the fundamental. In fig. 1, the upper diagram illustrates a quarter-wave of the fundamental, and the lower diagram illustrates the corresponding current (I) and pressure (U) waves for the third harmonic.

If the even harmonics be now considered, it will be found that conditions are analogous to those in an open organ pipe, and this leads to the consideration of half-wave lines which are discussed later. It will be seen that very long lines, of the order of 1,870 miles, for 50 cycles per second and 3,750 miles for 25 cycles, can be made to operate with only the pressure drop due to resistance.

Effect of Frequency Variations.—The remarkable properties of quarter-wave transmission being dependent upon resonance they are naturally sacrificed if the frequency changes. Some variations in frequency of supply being inevitable in practice, it is necessary to consider how these will affect the transmission.

Apart from abnormal fluctuations, which may be expected to disturb the transmission in other respects than as regards frequency alone, it is possible to keep the frequency constant within ± 1 per cent., or within ± 2 per cent. at the outside.

Keeping to the example chosen above, we have found that if the station current be increased automatically according to the law (265 amperes + 7 amperes per 18,000 KW.) at 50 cycles, the voltage between lines at the load is 173,000 volts constant within 1 per cent. If now the frequency rises 4 per cent., i.e., to 52 cycles, we have the following variations in current input required to maintain constant voltage at the load or approximately these variations in delivered voltage if the current input be constant. (See Table IV.)

TABLE IV.—Variation in Current Input for Constant Delivered Voltage at 52 Cycles compared with 50 Cycles.

Power factor.	Per cent. variation in current input for constant delivered voltage. Full load.	Half load.	No-load.
1·0	0·7	0·4	Open circuit, 0·2.
0·9	2·8	1·6	
0·8	4·0	2·4	
0·7	5·1	2·9	

For frequency variations of ± 2 per cent., the percentage current variations are about half those shown in Table IV, and therefore, do not constitute a factor of practical importance. If desired, the above law of current-input variation with load might be modified to take frequency variations into account.

Generators to be Adopted.—Alternators of the type now generally employed are not suitable for the supply of a quarter-wave line, and the considerable variations in pressure involved by the quarter-wave system necessitate the modification of the material used in constant-voltage stations. Alternators do not operate favourably at reduced voltage, particularly if the current is leading. One method of converting energy generated at constant potential into constant current would be by means of special transformers such as are used in A.C. series arc-lighting circuits. It is doubtful, however, whether constant-current transformers can be constructed for outputs of tens of thousands of kilowatts, and we are forced reluctantly to contemplate the series operation of generators. Existing synchronous alternators cannot be connected in series, at any rate, unless special precautions be taken.

According to M. Bunet, the solution probably lies in the use of commutator-type alternators, and, for experimental purposes, one might commence with a machine similar to a D.C. dynamo, but arranged for A.C. excitation. Reversing the field of a D.C. generator reverses the E.M.F. of the armature, and with A.C. excitation an alternating E.M.F. of the same frequency is produced at the brushes. Generators would be required for each phase. The field current, maintained accurately at 50 cycles per second, would be controlled by apparatus designed to maintain the current output of the generators at the predetermined value. The speed of the generators would have no influence on the frequency.

Such generators would present difficulties with regard to commutation, but, on the other hand, since they would necessarily be used in conjunction with transformers, their characteristics could be selected over a wide range to facilitate commutation. The sections of the windings short-circuited by the brushes would be the seat of E.M.F.'s induced by the alternating flux. The short-circuit currents might be reduced by high-resistance connections, but the problem is, broadly, the same as that in A.C. series-motors for traction purposes, and is one which has not been solved very satisfactorily, particularly for 50-cycle supply.

Another possibility lies in the use of polyphase machines with rotating fields, the commutation difficulties being reduced by suppressing the E.M.F.'s induced statically in the short-circuited sections. In this connection, M. Bunet recalls a polyphase generator with commutator which he saw running some years ago in the works of the Etablissements Postel Vinay. This machine operated satisfactorily, and had the characteristics of a series dynamo. It had a normal stator and a rotor analogous to that of a D.C. machine; the stator and rotor were connected to suitable inductances, and the machine was self-exciting. Its frequency varied somewhat with the load, but it would not be difficult to vary the speed automatically so as to maintain constant frequency. This machine was presented by Gratzmuller to the Société Internationale des Electriciens*, together with its characteristic curves and a communication which said, *inter alia*, that "the generator appeared to be applicable to constant current distribution."

Though it cannot be said that there are yet available alternators and other station equipment suitable for a quarter-wave transmission system, there is no reason to doubt that suitable material could quickly be developed by research based upon our present knowledge of electrotechnics. Such research work is justified by the fact that quarter-wave transmission undoubtedly offers the possibility of transmitting economically large quantities of electrical energy over distances far exceeding the limits of transmission hitherto accepted. The fact that the system is limited to "through transmission" from one point to another is not a very serious objection, because such transmission over long distances will form the main arteries of country-wide transmission and interconnection schemes in the near future. The quarter-wave line can be con-

* See *Bull.* de la Soc. Internat. des Electriciens, January, 1903.

nected in parallel with a local network fed on the ordinary present-day system and the half-wave system discussed in the concluding portion of this article offers the advantage that it can be tapped at or near the centre of its length if desired. In addition, the half-wave system requires no special type of alternator, and "artificial" half-wave lines should not be difficult to construct even for relatively short distances.

(To be continued.)

NATIONAL AGREEMENT ON ELECTRICAL WAGES IN THE CONTRACTING INDUSTRY.

The following is a copy of the Memorandum of Agreement between the National Federated Electrical Association and the Electrical Trades Union, to which we made a brief reference in our last issue :—

1. This settlement to be a complete national settlement as and between all districts in England, Wales and Ireland.

2. The new rates and grades shall come into effect on the first pay day following acceptance nationally by all districts, and signature by those authorised to sign on behalf of the respective parties to this agreement, *i.e.*, the N.F.E.A. and the E.T.U.

3. No change in the existing rates in any district to take place pending a notification of acceptance or rejection being officially given by the E.T.U. and the N.F.E.A. Such notification not to be later than four weeks from July 1st, 1920.

4. In the event of acceptance, the rates of pay for the various districts shall be those set forth in the schedule, which shall be standard rates. They shall not be altered except in accordance with this agreement, and shall not be subject to alteration under the rules provided for in district agreements. This clause does not prejudice the payment of more than the standard rate to any particular employé or employés selected on the ground of special ability or responsibility or long service.

5. Where, under this agreement, the increase due in any district exceeds 3d. per hour, the increase to come into effect on the date mentioned in Clause 2 shall be 3d. per hour only, and the balance of such increase shall come into effect on the first pay day in December, 1920.

6. Any alteration in grading may be agreed locally where due to incorrect grading, but no application for alteration shall be made on the grounds of any national variation in the cost of living. Failing settlement, the matter shall be referred to the Joint Executives of the N.F.E.A. and the E.T.U., whose decision shall be final and binding. No such alteration of the grading set forth in the schedule shall, however, take effect before February, 1921.

7. There shall be a review of wages in February and July of every year. Any application for increase or reduction must be in the hands of the secretaries of the N.F.E.A. or the E.T.U. not later than January 1st or June 1st, in any year, for consideration at the following joint meeting. Decisions arrived at on wages questions shall become operative as and from the dates agreed at such meetings.

8. This agreement shall apply to all qualified journeymen being members of the E.T.U. who are employed by electrical contractors in England, Wales and Ireland, except such employés who may be engaged for full time on manufacturing work under agreed engineering conditions.

SCHEDULE.

Grade A, 2s. 6d. per hour.—London. This rate includes a travelling allowance. No further allowances to be paid except as provided by Rule 9 of the London Rules, dated February, 1920.

Grade B, 2s. 3d. per hour.—Mersey District, Southport, Manchester, South Wales. Those towns and districts which have agreed to follow the Mersey and/or Manchester rates. Tyneside, The Hartlepools, Sunderland, Stockton-on-Tees, Middlesbrough, Darlington, West Riding of Yorkshire, Sheffield, Hull. Those towns in Yorkshire which have agreed to follow the West Yorkshire or Sheffield rates. Bristol, Birmingham, Coventry, Wolverhampton. Those towns which have agreed to follow the Birmingham rates.

Grade C, 2s. 1d. per hour.—The towns of Southampton, Portsmouth, Plymouth, Devonport, Chatham, Bournemouth, Bath, Luton. Towns and districts not specified above which are in the counties of Northumberland, Durham, Yorkshire, Lancashire, Cheshire, Lincolnshire, Norfolk, Suffolk, Essex (outside London area), Hertfordshire (outside London area), Nottinghamshire, Leicestershire, Derbyshire, Northamptonshire, Staffordshire, Sussex, Kent (outside London area), Surrey (outside London area), Middlesex (outside London area), Bedfordshire, Oxfordshire, Berkshire, Buckinghamshire.

Grade D, 1s. 11d. per hour.—The remaining counties and towns in England and Wales.

NOTE.—The grading of Belfast to be left open for further consideration.

Signed as at this date, August 7th, 1920.

On behalf of the National Federated Electrical Association :—

P. COLLINSON.
G. E. TAYLOR.

On behalf of the Electrical Trades Union :—

J. ROWAN,
J. KINNIBURGH.

REVIEWS.

Practical Electric Welding. By H. BEVAN SWIFT, A.M.I.E.E. London : E. & F. N. Spon, Ltd. 1919. Pp. ix+102; 66 figs. Price 7s. 6d. net.

The title of this book describes it accurately. It is a small and handy practical guide to electric welding of the three kinds in general use, and can be thoroughly recommended for the instruction of welders and teachers of welders. It does not profess to enter into the scientific questions of metallurgy, chemistry, and electrical matters involved, but it does touch on some of these things where the welder will come in contact with them and require to know something about them. In this abstention the book corresponds to the state of the art, as well as confines itself to its subject as indicated in the title. The art of electric welding is distinctly in the empirical stage in most respects, especially as regards arc welding. It has attained to its present stage by trial and error. There has been little research work on the subject of which any results have been published, and although there is a voluminous amount of material to be found in print, very little light has been thrown on the general principles, physical and chemical, involved.

The first chapter gives a short historical *résumé* of the art, which commenced with Elihu Thomson's discovery of resistance welding about 1877. This very simple process has since made immense strides in variety of applications and magnitude of the work handled. Benardos carbon arc welding followed about 1885, and about 1895 Slavinoff introduced the bare metallic electrode; in 1905 Kjellborg applied a fluxing covering to the metallic electrode which revolutionised arc welding, and has made possible the subsequent wide development in its use and application. There has been a great deal of experimental work done in recent years on the composition of the electrodes themselves and their coverings, which has resulted in the production of covered electrodes suitable for welding different kinds of iron and steel. The results of this work are either guarded as trade secrets or covered by patents. Very good practical results have been obtained, but as is usually the case where competition is a powerful factor, the general principles guiding such work are not public property.

Carbon arc welding is described by the author with a short preliminary description of the carbon lighting arc, which, however, differs considerably from the metal-carbon arc used for welding. The minimum voltage for a steady arc is considerably lower, due doubtless to the higher conductivity of the metal vapour than of the carbon "mist" in the carbon arc. Stress is laid on the importance of using graphite electrodes, and of making the work, *i.e.*, the metal, the positive electrode, in order to avoid carbon being carried into the weld. The author remarks that the carbon arc is mostly used for comparatively rough work, such as filling in large flaw holes in castings or building up defective portions, and for cutting metal, as in the demolition of bridges. This is true, yet the carbon arc has been used for many years past in work of a higher grade which has to stand severe tests, *e.g.*, in the manufacture of steel barrels. It is rather curious that its use for such work has not been extended in other fields, but there can be little doubt that metallic arc welding is superior, and has out-distanced the older method. The carbon arc can be used for welding copper, even copper to iron, and is largely used for track bonding with much success. The fact is rather remarkable, especially as it has not been shown that similar welds can be made with metallic electrodes.

Metallic arc welding is the method most fully described, and the instructions given, as might be expected from the author's practical knowledge, are very complete, and, on their practical side, accurate. In a statement of the properties of ferrous metals and their amenability to welding, a summary is given of the relevant differences between the varieties of iron and steel, as derived from the processes of manufacture, resulting composition, and behaviour at high temperatures. In describing the ordinary smith's weld, the main reason why this succeeds with wrought iron, &c., and not with other metals is missed. That reason is that the oxide scale which forms on the heated pieces is fusible, or at least plastic, below the melting point of the metal, and is, therefore, beaten or squeezed out by the smith's hammer, so that clean hot surfaces in a plastic condition are brought into contact. In most other metals the oxides formed have higher fusing points than the metal, and are, therefore, not removed by the pressure; this is the only obstacle to welding them, as is proved by the success of resistance welding, where heat is applied without oxidation of the surface. Arc welding is probably a misnomer; the union is effected by fusion of the surfaces, and it is really a process of "autogenous" soldering. It is doubtful whether the success of metallic arc welding has any relation to the amenability to welding of wrought iron and some of the steels, since cast iron and steels which are not weldable in the forge are successfully handled by the metallic electrode process. It is probable that success with the non-ferrous metals is only a question of

experiment and research, as is forcibly suggested by the success of welding copper and copper to iron with the carbon arc.

Welding with the bare iron electrode is rather lightly dismissed by the author. He is probably correct in thinking that the flux-coated electrode gives superior results. It certainly calls for a less skilled operator, and good work is done with it on various kinds of ferrous metals, which, so far as is known, has not been paralleled with bare electrodes. But a large amount of good work has been done with the latter, especially in the United States, and there are large scale users here who consider that the advantages of flux-covered electrodes are not worth the extra cost. This may be true for welding on very low carbon material, where the weld metal forming the joint can be practically pure iron, and still approximate sufficiently to the physical and mechanical properties of the parts to be joined. But it seems clear that where it is desirable that the weld metal shall carry carbon and other elements to approximate to the properties of higher carbon steels and other special metals, a flux coating is essential. It is in adjusting the composition of the electrode and the flux to attain this end that the art of the electrode maker is shown. The flux also has an important influence on the smooth flow of the fused metal, and relieves the operator of the difficulties arising from the iron oxide formed on both the electrode and the work in the absence of a flux.

The author shows a distinct preference for direct-current welding, though admitting that good work can be done with alternating current. This preference seems to rest upon use and wont. One finds that a welder who has generally used direct current prefers it, and *vice versa* with one who has generally used alternating current. There is, in fact, a little difference in the manipulation. With alternating current the best arc length is shorter than with direct current, and it is perhaps a little easier to "hold the arc" with the longer arc. But that is about all that can be said. Reasoning from the known fact that in the carbon arc carbon is transferred from the positive to the negative electrode, on which the transferred carbon forms a mushroom tip in short arcs, it might be supposed that the iron arc behaves similarly, *i.e.*, that the electrode should be the positive pole. But the transfer of the molten electrode metal to the joint certainly does not depend on any such uni-directional transfer. If it did, welding could only be done with direct current and the electrode positive. But welding can be done with alternating current, or with the electrode negative. So that if there is any uni-directional transfer of metal, and we do not know enough of the physics of the iron arc either to affirm or to deny this, such transfer is quite masked by other actions. What seems to happen is that the molten electrode metal is torn off and projected across the arc in very small particles, and at a high velocity, overcoming gravity, or "overhead" welding would be impracticable. The immediate cause of this transfer of metal and the quantitative relations between the amount of metal, the current, the potential difference, and the temperature of the electrodes have not been investigated. They call for inquiry, and the results of such research can hardly fail to benefit arc welding practice. Mr. Swift wisely refrains from speculation on this attractive subject.

With reference to the polarity of the work, it is recommended that the work be made the positive and the metal electrode negative. This is general practice, but the author adds that the work does not get so hot with this polarity. Presumably he has observed this in practice, but one would expect the difference to be in the other direction, because in the carbon arc, at least, the positive crater is hotter than the negative tip. There is also a greater surface potential drop at the crater, and consequently more heat developed there. It seems likely that the same thing obtains in the iron arc, and this should be the reason for making the work positive. Owing to its much greater mass the heat is conducted from the seat of the arc much more rapidly through the work than through the electrode, consequently to keep the work at welding temperature, the greatest evolution of heat should occur there. Even so it will be at a considerably lower temperature than the electrode. If this is correct, then *for a given welding current* the work will be hotter—not cooler, as the author says, when made the positive electrode. A possible explanation of the apparent contradiction is that when the work is negative a greater current is necessary to keep its surface at the necessary temperature. Or it may be that the iron arc does not follow the carbon arc in the distribution of temperature and heat evolution. We really want someone to do for the iron arc what Mrs. Ayrton did for the carbon arc, before we can profess to understand iron arc welding in a scientific way.

Mr. Swift goes very fully into practical details. The electrode holders, protective screens, and other items of equipment are described, illustrated, and commented on. The various kinds of joints which have to be made are shown, and the exact way of attacking each is described. The importance of observing the weld in progress, the position of the slag, how to join up to a weld, and how to terminate it neatly, are all dealt with in the direct and clear way of the expert who can not only do the job, but describe the how and why of each action; what to avoid as well as what to do. The table of electrode sizes and current, and the procedure with welds in work of different thicknesses will be found of great utility to the beginner and the instructor.

In dealing with the adaptation of general electric supply to welding uses, Mr. Swift shows a due appreciation of the supply engineer's point of view, and how the user can meet his just requirements. The conditions of the work are shown to affect the choice of equipment. It makes all the difference to the most economical arrangements whether a group of welders are to work close together in a workshop, or are scattered about a shipyard, &c. There is already a considerable choice of outfits, motor generators, transformers, &c., on the market to suit welding. Something of this kind is required in every case where the energy is taken from supply mains, because the welding arc voltage is much lower than supply voltages, and direct use with a resistance is too wasteful—as well as too disturbing to voltage—to be contemplated for other than small or temporary jobs where the cost of energy is not regarded.

Passing from arc welding, Mr. Swift gives a good description of resistance welding and various forms of welders on the market. The great adaptability of this process is well illustrated, but the magnitude practicable is perhaps insufficiently indicated. Resistance welders are in being which will spot weld steel plates three inches thick. There is a very great future for resistance welding, it will probably become much more important as a manufacturing process than arc welding, though the latter has no doubt great potentialities, and the two methods are really coadjutors rather than rivals.

With regard to the important question of protective screens for arc welding, Mr. Swift's remarks are pre-eminently cautious and practical. One gathers that he is not altogether satisfied with the glasses now used. The outstanding difficulty is that glasses which efficiently protect the eyes from the arc rays are too dark to permit vision of the surroundings of the arc, so that the operator cannot see his tools, &c., through them. It would be a great improvement to have a combination of glasses efficient as shields, and yet allowing other things than the arc to be seen. The direction to work in is to find glasses which allow only light about the yellow-green part of the spectrum to pass. This is the most efficient part of the spectrum visually, *i.e.*, it produces the greatest effect on the retina in proportion to the radiant energy involved. The spectral rays which carry the most energy are the infra-red and the red, these are to be feared as burning the skin and external eye. Violet rays damage the retina, but they are not difficult to exclude. Clear water stops the infra-red almost entirely in very small thickness. It should not be difficult to arrange a shield with a cell containing this cheap absorbent and readily refilled. For the rest, the work of the makers of light filters for photography ought to be able to supply glass or gelatin films giving a nearly monochromatic yellow-green. Gelatin has some advantages over glass for the purpose. It may be mentioned that one of the speediest cures for the sore eyes produced by arc radiations is a very dilute (1 grain per ounce) water solution of sulphate of zinc. It was always kept in the arc testing rooms of arc lamp factories, and removes the smart and inflammation magically.

There are a few points in the book which call for criticism, rather because they tend to mislead the reader on other matters than because they detract from its immediate purpose.

On page 4, dealing with the formation of an arc, it is stated that the air at the point of contact is heated and becomes of *lower* conductivity, thus enabling the arc to be maintained. Obviously *higher* conductivity is meant. On page 18, the process of making malleable iron castings is described in language which will hardly convey a correct idea. On page 41, the ratio of metal lost in overhead welding with alternating current as against direct current seems rather overstated as against alternating current, but the author may have measured it, and the reviewer has not.

In describing (pp. 75 and 76) the Ulbricht method of getting a single from a 3-phase supply, by joining the three secondaries of a three-phase transformer in series, reversing one of them, the author says that the resultant current has triple the primary frequency, and 1.73 times the pressure of one secondary. In fact the pressure is twice that of one secondary and the frequency is not increased. (See "Polyphase Electric Currents," Thompson, Chapter XIV, which describes also some other methods of obtaining single from three-phase, perhaps worth the attention of users of arc and resistance welders.) On p. 77, the author suggests that the phase displacement caused by a choker results in economy, because the meter will show a lower reading for the same current. This does not seem quite true; at least it is an awkward way of saying what is true.

Perhaps the most remarkable omission is that hardly any mention is made of tests to be applied to determine the quality of welds. The author's silence is perhaps best explained by the fact that there is no specific test for welds. But some reference might have been made to microscopic and radiographic methods, which have a certain measure of utility and have been developed to some extent. Also to mechanical tests on both welds and weld metal which have been made and published on good authority.

These points are, however, trifling, and the book is to be strongly recommended to everyone anxious to know what can be done by electric welding, and how to set about doing it on correct lines.—H. M. S.

ALTERNATING CURRENT TRACK CIRCUITING.

By L. H. PETER, A.M.I.E.E.

(*Abstract of paper published in the Journal of the* Institution of Electrical Engineers.)

It is not the author's intention to deal with the methods of applying alternating current to track circuits, but rather with the factors that must be taken into account when deciding on the apparatus to be used. The apparatus forming a track circuit of the simplest kind may be considered as comprising a transformer or other method of supply, a regulating device for adjusting the supply, and a relay. To illustrate good and bad combinations of relays and impedance bonds, vector

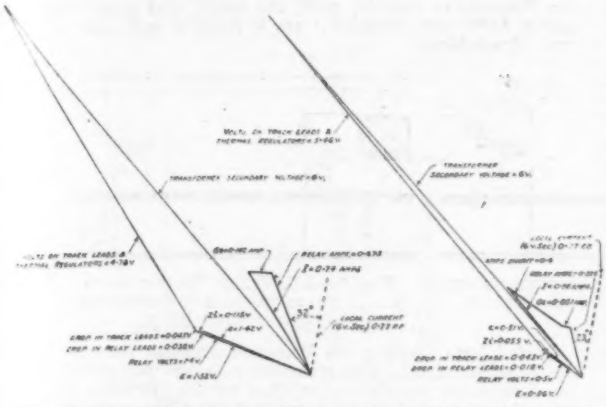


Fig. 1.—Single rail tracks without impedance bonds, with a resistance in feed, and galvanometer relay. Supply = 33⅓ cycles. Track circuit = 1,000 ft. long. Track clear.

Fig. 2.—Train shunted at transformer end.

Figs. 1 and 2.=Vector Diagrams.

diagrams are drawn with the " in phase " and " quadrature " operating values of the relays used; the corrected values for the relays operating at the phase angles shown on the various diagrams have been omitted to avoid complication. Some explanation is due for adopting the non-inductive shunt for these diagrams. If the shunt circuit formed by a pair of wheels joined by an axle and standing on the track is considered, it may be regarded as consisting of three parts: (*a*) The contact resistance from the rail to one wheel. (*b*) The inductive circuit formed by the axle and two wheels. (*c*) The contact resistance from the second wheel to the second rail.

Both (*a*) and (*c*) are non-inductive; (*b*) is inductive and, owing to the half loop formed by the wheels and axle and the skin effect of both these, it may have a comparatively low power factor. Tests have shown that the contact resistance between rail and wheel is many times the impedance between wheel and wheel, and we have, therefore, a series circuit with two high resistances in series with a small inductance, the net result of which is to give a circuit that for all practical purposes may be taken as non-inductive. This is still more the case when the rail and wheel contact resistance increases to a value which would be commensurate with the shunting-out value of the relay, as the contact resistance, which is non-inductive, will then be so many times greater than the small impedance between wheels that the latter may be neglected and the shunt-circuit power factor taken as unity.

Taking first the A.C. track circuit in which one rail is given up wholly for signalling purposes. The electrical state of such a track circuit with an " in phase " relay is that shown in fig. 1 when the track is clear, and as shown in fig. 2 when the track is shunted by the maximum train shunt at the transformer end. The relay is operating with the track current 32 deg. displaced in phase from the local current, and we must, therefore, divide the " in phase " operating values by the cosine of 32 deg. to get the correct operating values with this phase displacement.

When the track is shunted by the application of a non-inductive train shunt (resistance 1.4 ohms) at the transformer end, the phase displacement between track and local currents is reduced to 23 deg., and the release values for the relay will accordingly be the " in phase " release values divided by the cosine of 23 deg. The diagrams show a thermal resistance between the track transformer secondary and the rails, this resistance being so adjusted that the total current output from the transformer to the track may be said to remain constant whether the track is occupied or not.

Fig. 5 shows the values of such a resistance; with a pressure rise across the resistance from 4.76 volts in fig. 1 to the 5.46 volts shown in fig. 2, the current increase would be practically nil, as we should be working on the flat portion of the curve.

The relay track current vector is comparatively large; if we can increase the relay impedance and also reduce the volt-amperes required for it from the track, we shall greatly improve the shunt value.

The conditions shown above are good so long as one of the track rails can be spared for signalling purposes only; but when both rails are required for the propulsion return current the addition of the impedance bonds necessary to carry this current alters the vector diagram. With impedance bonds of low power factor connected across each end of the track circuit and a relay of the " in phase " type, the comparatively low impedance and low power factor of the two bonds reduce the shunt at the transformer end of the track. The phase angle between the track and local currents is also large when the track is clear, and small when it is shunted. This is a bad case, as the relay condition is improved when the track is shunted, thus necessitating a lower shunt resistance to drop the relay. The " quadrature " relay is obviously more suitable for use with this type of impedance bond. The large currents passed by the two bonds, however, account for the high total current, and if the impedance of the bonds could be increased so as to reduce the current vectors, we should also be able to reduce the size of the track transformer, resistance, and leads to correspond. The reduction in track current is made by the use of resonated impedance bonds, and improves the shunt values considerably on the same track circuit, and with the same relay. In addition we must also count the improved phase relationship of the track and local currents, and particularly the small relative change in this phase relationship which now takes place when the track is shunted. It is still possible, however, to improve the relay-operating conditions by adjusting the reasonated impedance bonds to have a leading power factor, and so compensate for the difference between the track and local currents. It is unsatisfactory to use a " quadrature " relay with the resonated type of bond and resistance in the track feed. To be able to place the track relay some distance from the end of the track circuit economically with regard to cable, a relay transformer is inserted, the track voltage being stepped up for transmission to the relay. The result, however, is the introduction of further complication in the vector diagram, the net result of introducing the relay transformer being a decrease in the power

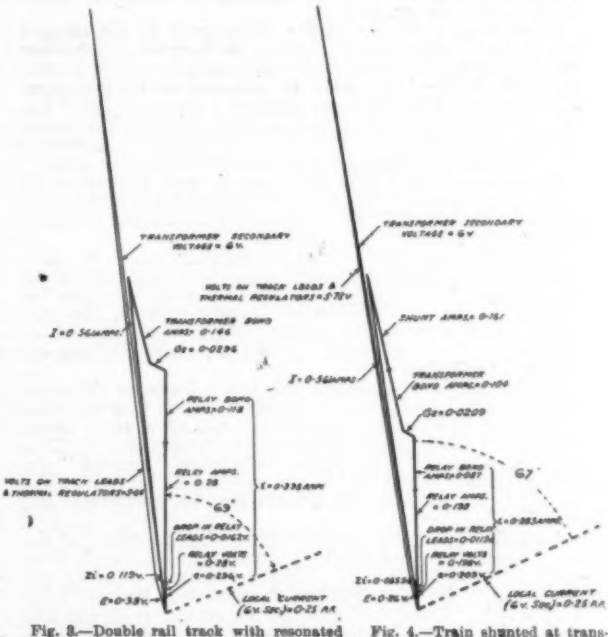


Fig. 3.—Double rail track with resonated impedance bonds, two-element vane relay and condenser in track winding. Supply = 60 cycles. Track circuit = 1,000 ft. long. Track clear.

Fig. 4.—Train shunted at transformer end of track.

Figs. 3 and 4.—Vector Diagrams.

factor between the relay and the track at the relay end of the track. The current taken from the track is now also high. There is no great advantage in substituting a " quadrature " for the " in phase " relay. Several methods have been adopted for varying the power factor of the relay in order to enable the best operating conditions to be obtained. One of these, which has been used on the " quadrature " relay,

consists in adding another winding to the iron core on which the track winding of the relays is mounted, and connecting this additional winding to a small capacity. By this means the power factor of the track winding can be brought up to "unity."

Figs. 3 and 4 show a double-rail track circuit with resonated impedance bonds, and a relay in which the power factor of the track winding has been made "unity" by this method. This gives a very good combination for a double-rail track circuit, the normal phase displacement on the relay being 69 deg. and the phase displacement when shunted varying only 2 deg.; the high shunt value of 1.62 ohms is obtained.

Another method of controlling the phase angle on the relay is to feed the track circuit through a condenser of variable capacity, or to use a capacity and inductance in series, the two being so adjusted in relation to one another that the current supply to the track may be given an angle of "lag" or "lead" as desired. This method is shown in fig. 6. The supply feeds the primary of a "step-down" transformer through a condenser, the secondary of the transformer being connected direct to the track rails with or without intermediate means of regulation. Adjustment may be made by varying the number of turns of the primary winding, capacity being maintained constant.

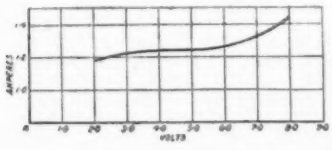


Fig. 5.—Thermal Resistance.

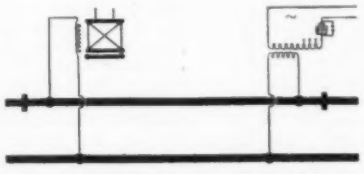


Fig. 6.—A.C. Track Circuit with Capacity and Inductance in Feed Circuit.

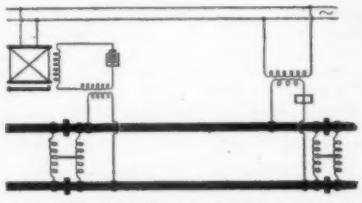


Fig. 7.—A.C. Track Circuit with Relay Transformer and Condenser in Series with Relay.

Damage from pressure-rises due to any cause is protected against by the use of safety spark-gaps across the condenser terminals. By adjusting the number of primary turns in relation to the capacity, the voltage across the condenser can be maintained at a point slightly above the pressure of the mains while the track is "clear." When the track is "shunted," the short-circuit of the secondary winding of the transformer so reduces the inductance of the transformer that the pressure of the mains only is placed across the condenser terminals. This results in a decrease of the current passed by the condenser, and a corresponding decrease in the current output to the track on the secondary side. This is of great value in the track circuit as it enables a higher shunt value to be obtained.

In addition, a change in the phase angle of the current also is made which can be utilised to improve still further the shunt value, by so arranging the track circuit that with the track "clear" the relay is operating at its maximum efficiency, and that when the track is "short-circuited" the phase angle changes in such a way as to make the relay-operating conditions less efficient. This method of feeding is most suitable for single-rail track circuits fitted with quadrature relays. In this case the capacity and inductance in series are so adjusted that their power factor is "unity," the quadrature relay itself being designed so that its two windings have widely different power factors.

When the track is "clear," the capacity and inductance supply current which gives a 90 deg. phase displacement on the relay; and when the track is short-circuited and the inductance of the feed transformer thereby reduced, the condenser supplies a leading current which brings the phase angle of the two currents on the relay to a phase displacement of less than 90 deg.

Another method of altering the power factor of the relay track element to suit all the conditions consists in introducing a capacity between the high-voltage side of a relay transformer and the relay track element, as shown in fig. 7. This, however, does not give to the track when "shunted" the falling current output which can be obtained by feeding the track circuit through the combination of inductance and capacity.

A small capacity introduced between the secondary of the relay transformer and the relay track winding, fig. 7, gives similar results to those of adding a condenser winding and condenser to the relay, but has the advantage that the relay need not be altered. This is an advantage, as a standard design of relay can be used with or without the relay transformer, and with either the resonated or non-resonated bond.

(To be concluded.)

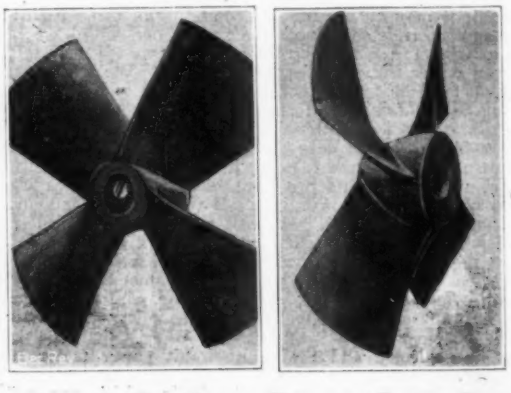
Physical Society of London.—As a result of replies received in response to a questionnaire recently circulated to Fellows with reference to days and time at which science meetings should be held, the Council has arranged to hold meetings during the coming session at the uniform hour of 5 p.m. on the second and fourth Fridays of the month.

HIGH-SPEED WHEELS FOR LOW-HEAD HYDRAULIC TURBINES.

One of the difficulties encountered in hydro-electrical work is the suitable treatment of cases where the available head is unsuitably low. The account, which we abstract below from the *Electrical World*, of a typical low-head plant that was put into commission in January last by the Consumers' Power Co., near Plainwell, Mich., U.S.A., will, therefore, not be out of place.

In the new plant, which is novel in several respects, and is probably the first of its kind, there are three penstocks each of which contains a 72-in. (183-cm.) Allis-Chalmers-NX type turbine, operating at 164 r.p.m., and delivering 380 b.h.p. under a head of 12 ft. (3.6 m.). This type of machine as developed by Mr. F. Nagler, constitutes a material advance in turbine design, and shows at increasing speeds the characteristics of the Fourneyron turbine, with the result that much higher speeds have been attained than is possible with any other type of machine.

At full gate opening the Plainwell turbines show a type characteristic of 143. The runner is an entire departure from the Francis, or so-called mixed-flow turbine, it being of the Jouval type with important innovations. The arms of the old Jouval machine to which the bucket ring was fastened, are eliminated entirely, and the buckets drawn back to the hub. The reduction of the number of blades has been carried to the limit, having been reduced to 4, which are placed widely apart, so that the blades and clearances between them each occupies about ¼ of the total projected area of the runner. In this manner a very high type characteristic has been obtained. The new turbines at present show a maximum Holyoke efficiency of from 86 to 87 per cent. The two views,



Figs. 1 and 2.—New Type of Hydraulic Turbine Runner.

figs. 1 and 2, show the new type of runner, which has the general appearance of an ordinary propeller. The runner is made of cast iron, and is placed in a turbine case of ordinary design. The wide space between the blades is of great advantage from an operating standpoint, as it makes it impossible for the wheel to become clogged by trash.

The new type of turbine requires a draught tube of as great a length as possible in order to attain the necessary efficiency. The tube is made of steel plate in the form of a flaring cone with a vertical axis of the hydraucone type. The characteristic of the tube is that the distance from the tailrace bottom to the draught-tube edge is comparatively small, and the flare at the lower diameter is great.

On account of the large size of the turbine for the head, and the high elevation of the centre of the turbine case made necessary by the length of the draught tube, the wheel centre of the Plainwell plant came too near the head water to ensure satisfactory operation in the ordinary way. The so-called "vacuum-turbine" setting, first introduced by the Escher-Wyss Co., of Switzerland, was, therefore, used as illustrated in fig. 3. The Plainwell machines are still, however, under the ordinary headwater, but the water level over the turbine

when operating is raised about 6 ft. (1.8 m.) above the head-water in the pond, and rises to the underside of the generator room floor, the entrance being sealed by a curtain wall. The concrete penstock, therefore, is entirely closed, and operates under a partial vacuum, the air being constantly removed by means of a small water ejector. The water consumption of the latter is insignificant compared with the discharge of the turbine.

With the plant in operation the vacuum was tested and found to be 5.75 in. (13.3 cm.) at normal pond level, which showed that the penstock was full of water to the underside of the generator floor. The turbines have not yet been tested, but are fulfilling the power guarantees.

An interesting feature is the unusually small size of the generator, as compared with the size of the turbine; this is due to the high turbine speed, which also permits the economical use of direct-connected exciters on top of the generators.

The latter are 400-K.V.A., 320-KW., 0.8 power fector, 164-R.P.M., 2,500-volt, 3-phase, 60-cycle General Electric Co. machines. They are provided with alarm thermometers and oil gauges to control the oil level in the thrust bearings, which are of the G.E. Co. spring-thrust and guide-bearing type. The Woodward governors are of 6,700 ft. lb. (924.6 kg. m.) capacity, and are belted to the turbine shaft. At times of

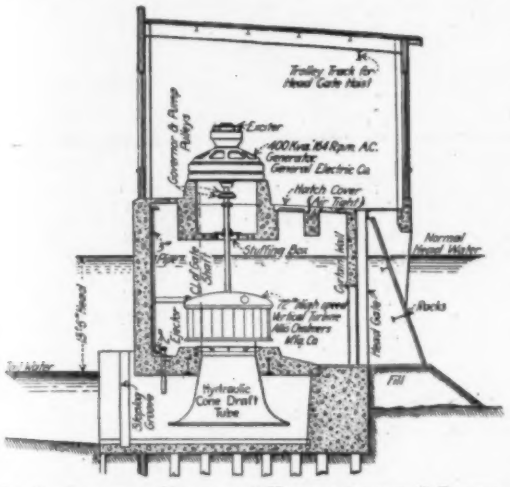


Fig. 3.—Sectional View of "Vacuum-turbine" Setting.

low water one or more of the machines may be used as a synchronous condenser to improve voltage conditions on the transmission lines. This is possible because in this type of machine no bearings depend on the passage of water through the wheels for lubrication or cooling purposes. Three single-phase, H-type, 400-K.V.A., 2,500-45,000-volt, outdoor transformers step up the generated pressure for transmission, and the 40,000-volt, 400-amp. switch is automatically and hand operated. The entire plant is operated by one man on each shift.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR JUNE, 1920.

The official returns of electrical exports and imports for the month of June show, as regards the exports, total values of £1,385,974, as compared with £1,150,234 for the previous month, an increase in values of £235,740, the increase being accounted for by the large submarine telegraph cable exports of £416,000. A falling off in export values during the month occurred in electrical goods (£10,000), insulated wire (£67,000), batteries (£9,000), and meters (£10,000), whilst the values of electrical machinery, lamps, telegraph and telephone exports were somewhat above those for May.

The electrical imports for the month were valued at £219,440, an increase of £26,000 on the May totals of £193,235, nearly every section of the imports showing an improvement with the exception of insulated wire, carbons and lamps.

Re-exports of foreign and colonial electrical goods for June show a falling off of £6,000, the total values for May and June being £18,699 and £12,512 respectively.

For comparison, we give figures showing the electrical exports for the first six months of 1913, 1919, and 1920:—

	1913.	1919.	1920.
January to June ...	£3,843,720	£2,806,013	£6,205,296

The total weight of electrical machinery exported during June totalled 817 tons, as compared with 697 tons in May, 915 tons in June, 1919, and 2,527 tons in June, 1913.

For the six months ending June 30th, 1913, 1919 and 1920, the total weights of electrical machinery exported were as follows:—

1913.	1919.	1920.
13,785 tons.	4,754 tons.	4,778 tons.

Values of Electrical Exports and Imports for June, 1920.

	Exports.	Imports.	Re-exports.
Electrical goods and apparatus (unenumerated)	£152,807	£68,841	£2,832
Insulated wire	346,248	11,454	1,174
Glow lamps	27,520	2,403	237
Arc lamps and parts	2,825	743	—
Batteries...	39,734	5,288	—
Meters	34,904	12,702	521
Carbons	10,650	7,233	3,905
Electrical machinery:—			
Railway and tramway motors...	3,203	—	—
Other motors and generators ...	115,415	—	—
Elec. machinery (unenumerated)	54,996	95,068	2,243
Switchboards (not telegraph or telephone)	9,695	—	—
Telegraph and telephone cable and apparatus:—			
Telegraph and telephone wires and cables (not submarine)...	89,615	1,175	—
Submarine telegraph and telephone cables	416,853	—	—
Telegraph and telephone instruments and apparatus ...	81,509	14,533	1,600
Totals	£1,385,974	£219,440	£12,512

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

20,248. "Electrolytic production of tin deposits." M. Schlotter. July 9th. (Germany, March 15th, 1917.)

20,263. "Contact fingers for controllers." Soc. Anon. Constructions Electriques de Belgique. July 9th. (Belgium, March 18th, 1919.)

20,264. "Electric traction." Soc. Anon. Constructions Electriques de Belgique. July 9th. (Belgium, May 24th, 1919.)

20,279. "Electric heating apparatus." L. de Soissan. July 9th. (Belgium, December 19th, 1913.)

20,288. "Electric generating systems." Kohlër Co. July 9th. (U.S., March 20th, 1919.)

20,308. "Electric signalling." A. van T. Day. July 9th. (U.S., July 17th, 1916.)

20,309. "Automatic railway traffic controlling systems." A van T. Day. July 9th. (U.S., October 18th, 1916.)

20,319. "Arc lamps for producing flashes of lightning." Schwabe & Co. July 9th. (Germany, December 10th, 1914.)

20,322/3. "Insulators." R. M. Johnston. July 9th.

20,338. "Telephone and telegraph cables." Soc. Industrielle des Telphones. July 9th. (France, April 4th, 1919.)

20,343. "Generating continuous currents by means of machines." C. Lorenzais & K. Schmid. July 9th. (Germany, February 13th, 1919.)

20,930. "Telegraphy, &c." Dr. E. F. Huth Ges. July 12th. (Germany, September 15th, 1915.)

20,931. "Method for generating and reinforcing vibrations for wireless telegraphy." Dr. E. F. Huth Ges. July 12th. (Germany, July 17th, 1918.)

20,932. "Appliance for vacuum tubes." S. Loewe. July 12th. (Germany, July 9th, 1918.)

20,933. "Arrangement for wireless telegraphy from submarines." Dr. E. F. Huth Ges. July 12th. (Germany, December 8th, 1916.)

20,934. "Method of connection to produce oscillations with vacuum tubes." Dr. E. F. Huth Ges. July 12th. (Germany, July 16th, 1917.)

20,935. "Reception process for electrical vibrations." Dr. E. F. Huth Ges. July 12th. (Germany, May 5th, 1919.)

20,936. "Antenna for wireless telegraphy." Dr. E. F. Huth Ges. July 12th. (Germany, July 14th, 1915.)

20,937. "Connection for sending and receiving electric waves." Dr. E. F. Huth Ges. July 12th. (Germany, October 13th, 1917.)

20,938. "Device for transmitting high-frequency energy to vacuum tubes." S. Loewe. July 12th. (Germany, October 19th, 1918.)

20,947. "Manufacture of electrodes for soldering, &c." Alloy Welding Process, Ltd., and E. H. Jones. July 12th.

20,952. "Inclined carbon lamp." R. Mylo. July 12th. (Germany, January 28th, 1918.)

20,953/4. "Process for photographically recording sound waves." R. Mylo. July 12th. (Germany, November 10th, 1915.)

20,955. "Arrangement for surging reception of electric waves." Dr. E. F. Huth Ges. July 12th. (Germany, April 29th, 1919.)

20,956. "Combined transmitting and receiving arrangement." Dr. E. F. Huth Ges. July 12th. (Germany, December 14th, 1917.)

20,957. "Multiple boosters, &c." Dr. E. F. Huth Ges. July 12th. (Germany, March 8th, 1917.)

20,958. "Electric discharging vessels." Dr. E. F. Huth Ges. July 12th. (Germany, April 3rd, 1917.)

20,959. "Receiving arrangement for wireless telegraphy." Dr. E. F. Huth Ges. July 12th. (Germany, October 28th, 1918.)

20,960. "Device for preventing self-sounding in vibration producers, &c." Dr. E. F. Huth Ges. July 12th. (Germany, July 4th, 1917.)

20,961. "Connection for telephony." S. Loewe. July 12th. (Germany, October 29th, 1918.)

20,962. "Radio-telegraphic apparatus." Dr. E. F. Huth Ges. July 12th. (Germany, August 28th, 1917.)

20,963. "Transmitting undamped electric vibrations." Dr. E. F. Huth Ges. July 12th. (Germany, July 21st, 1917.)

20,964. "Connection for obtaining a strengthening of wireless messages." Dr. E. F. Huth Ges. July 12th. (Germany, June 11th, 1917.)

20,965. "Mode of putting in circuit of audion receivers." S. Loewe. July 12th. (Germany, April 18th, 1918.)

20,992. "Apparatus for wireless transmission of messages." S. Loewe. July 12th. (Germany, October 26th, 1918.)

20,993. "Wireless telegraphy and telephony." Dr. E. F. Huth Ges. July 12th. (Germany, August 18th, 1917.)

20,994. "Three-arm choking coil." Allgemeine Electricitäts-Ges. July 12th. (Germany, September 17th, 1914.)

20,995. "Receivers with strengtheners." S. Loewe. July 12th. (Germany, April 18th, 1918.)

20,997. "Arrangement for receiving electric oscillations." Dr. E. F. Huth Ges. July 12th. (Germany, April 26th, 1919.)

21,000. "Sparking plugs." J. Hanman. July 12th.

21,003. "Receiving connection with vacuum tube." Dr. E. F. Huth Ges. July 12th. (Germany, October 13th, 1917.)

21,004. "Electric contacts for switches, &c." G. Page and A. West & Co. July 12th.

21,023. "Electrolytic devices for use with meters, switches, &c." Thorpe Meter Syndicate and W. B. Thorpe. July 12th.

21,025. "Sound-detecting systems." E. A. Graham and W. J. Rickets. July 12th.

21,027. "Manufacture of coils for static transformers." British Electric Transformer Co. and J. Roothaan. July 12th.

21,040. "Manufacture of armatures of electric rotating machines." T. Tanaka. July 12th. (Japan, July 11th, 1919.)

21,047. "Electromagnet for locking devices." Luftfahrzeugbau Schütte-Lanz. July 11th. (Germany, October 17th, 1916.)

21,051. "Manufacture of carbon electrodes." S. E. Sieurin. July 12th.

21,056. Driving system for alternating-current meters. Allgemeine Elektricitäts Ges. July 12th. (Germany, December 31st, 1918.)

21,058. "Generator with movable grates." Allgemeine Elektricitäts Ges. July 12th. (Germany, June 17th, 1918.)

21,060. "Vacuum tube." S. Loewe. July 12th. (Germany, April 20th, 1918.)

21,067. "Safety switch for installation systems, &c." Allgemeine Elektricitäts Ges. July 12th. (Germany, November 6th, 1913.)

21,077. "Coin-freed meter for electric current, gas, water, &c." Allgemeine Elektricitäts Ges. July 12th. (Germany, September 19th, 1914.)

21,078. "Coin-freed meter for electric current, gas, water, &c." Allgemeine Elektricitäts Ges. July 12th. (Germany, July 4th, 1917.)

21,092. "Device for heating running water by electricity." H. Lipke. July 12th. (Germany, April 25th, 1914.)

21,094. "Talking machine with electric impulsion." A. Ebner. July 12th.

21,095. "Automatic disengaging devices for talking machines worked by electric motor." A. Ebner. July 12th.

21,103. "Apparatus for electrical transmission over wires or by wireless of photos and pictures." M. R. Howard. July 13th.

21,106. "Vehicular electric lighting and starting." W. J. Branson. July 13th.

21,113. "Long-distance electric power transmission." A. M. Taylor. July 13th.

21,128. "Means for retaining trollies on wires." L. F. Brommage. July 13th.

21,139. "Electrically bonding metallic circuits." C. Lye. July 13th.

21,149. "Portable electric hand lamps." Concordia Elektricitäts Akt.-Ges. and F. R. Wade. July 13th.

21,150. "Sparking plugs." T. S. Price. July 13th.

21,178. "Electric propulsion of ships." M. de Coninck. July 13th. (France, July 15th, 1919.)

21,179. "Three-electrode ionic tubes." Radio Communication Co., J. Ree, and L. B. Turner. July 13th.

21,202. "Appliance for testing magnetos and sparking plugs." E. R. Gardner. July 14th.

21,231. "Trollies for overhead electric tramways." W. Lawrence. July. 14th.

21,251. "Portable dynamo-electric lamp." G. Poole. July 14th.

21,256. "Radio signalling systems." L. de Forest. July 14th. (United States, May 10th, 1915.)

21,271. "Electric transformers." British Electric Transformer Co. and J. Roothaan. July 14th.

21,304. "Dynamo electric machines." British Thomson-Houston Co. and F. P. Whitaker. July 14th.

21,317. "Devices for locking incandescent electric lamps." G. F. Colson. July 15th.

21,330. "Earthing clip for electric cables, pipes, tubes, &c." H. Willis. July 15th.

21,336. "Means for electrically reciprocating hammers, pistons, &c." G. F. Campbell, J. Knight, and J. Tattersall. July 15th.

21,340. "Electric fuse holders." R. T. Waite. July 15th.

21,341. "Electrically driven vehicles." F. M. Walters. July 15th.

21,354. "Wireless telephone transmitters." A. R. Taylor. July 15th.

21,370. "Switches for electric lighting." A. Schellenberg. July 15th.

21,381. "Driving electric mechanism for operating rail track apparatus." T. Ducousso. July 15th.

21,382. "Reception of wireless signals." Marconi's Wireless Telegraph Co. July 15th. (United States, July 28th, 1919.)

21,383. "Variable electrical controlling elements for wireless telegraphy, &c." Marconi's Wireless Telegraph Co. July 15th. (United States, July 31st, 1919.)

21,385. "Dynamometers." T. H. Jones and W. J. Walker. July 15th.

21,389. "Electric induction regulators cooled by forced draught." Akt.-Ges. Brown, Boveri et Cie. July 15th. (Switzerland, July 15th, 1919.)

21,490. "Dynamo electric machinery." H. E. M. Barlow and L. Barlow. July 16th.

21,421. "Electric bells, &c." A. Fisk. July 16th.

21,450. "Wireless directional transmission and reception apparatus." T. H. Gill. July 16th.

21,461. "Electrical and mechanical locks for lift gates." W. G. Carter. July 16th.

21,481. "Electric arc-welding apparatus." Siemens-Schuckertwerke. July 16th. (Germany, August 19th, 1919.)

21,490. "Electric arc welding." British Thomson-Houston Co. (General Electric Co.). July 16th.

21,492. "Apparatus for converting heat into electrical energy." F. E. Beeton. July 16th.

21,504. "Circuit closers." E. F. Nichols. July 16th.

21,505. "Apparatus for breaking, commutation, inversion, and deviation of an electric current." Z. R. Della Veneria. July 16th.

21,507. "Dynamo electric machines." A. E. Honey and J. Stone & Co. July 16th.

21,511. "Electrically driven trucks." J. E. Stott. July 17th.

21,522. "Support of accumulator boxes to seat pillar of motor cycles, &c." S. E. Pope-Arridge and W. S. Firth. July 17th.

21,537. "Trigger relays for radio communication, &c." Radio Communication Co., J. Scott-Taggart, and L. B. Turner. July 17th.

21,538. "Modulation systems, &c., in radio communication, &c." Radio Communication Co. and J. Scott-Taggart. July 17th.

21,541. "Cover for electric switches." S. S. Södring and N. P. E. Winther. July 17th.

21,568. "Portable electric lamps." J. Marsh. July 17th.

21,572. "Globe with device for showing action of earth's magnetism." E. G. Schlatyer. July 17th.

21,585. "Wireless telegraphy." S. O. E. T. Trost. July 17th. (Denmark, July —, 1919.)

21,595. "Electrical ceiling roses, &c." Hale, Pearn & Co., and J. A. Pearn. July 19th.

21,596. "Driving magneto-ignition apparatus for internal combustion engines." M. S. Connor and C. C. Puckette. July 19th.

21,604. "Telemeters." Firm of C. Zeiss. July 19th. (Germany, July 21st, 1919.)

21,609. "Relays for automatic telephone, &c., systems." Automatic Telephone Manufacturing Co. (Automatic Electric Co.). July 19th.

21,619. "Apparatus for distance control of electric switches." E. Schattner. July 19th.

21,628. "Conduit fittings for electric conductors." H. March, March and Newey, and W. Newey. July 19th.

21,641. "Adaptors for holding carbons in arc lamps." G. C. Bridgland. July 19th.

21,655. "Insulating material." J. A. van der Nolle. July 19th. (Holland, July 19th, 1919.)

21,666. "Electric clocks." L. Pillon. July 19th.

21,676. "Burning carbon electrodes in electric furnaces." S. E. Sieurin. July 19th.

21,683. "Signalling through water or air." R. A. Fessenden. July 19th. (United States, July 21st, 1919.)

21,684. "Telephone repeating circuit." Western Electric Co. July 19th. (United States, July 31st, 1919.)

21,699. "Battery-filling machines." L. A. Freedman. July 19th.

21,712. "Amplification of telephone currents, &c." T. F. Wall. July 20th.

21,713. "Electric lamp holders, &c." E. E. Hopwood and Wardle Engineering Co. July 20th.

21,721. "Magnetic motors." W. Thompson. July 20th.

21,725. "Automatic switch for electric hoists, &c." A. Satterthwaite. July 20th.

21,726. "Electric incandescent lamps." U. Cristofoletti and N. Manetti. July 20th.

21,732. "Spark plugs." H. A. Myers. July 20th.

21,735. "Telephones." G. B. Riley. July 20th.

21,745. "Electric welding." E. Greenhalgh and B. Longbottom. July 20th.

21,755. "Electric switches." C. L. J. B. Nadaud and F. Young. July 20th.

21,756. "Apparatus for electro-chemical treatment of vapours." L. B. Cherry. July 20th.

21,766. "Contacts for electrical fuses, cut-outs, &c." W. A. Harriman and A. Reyrolle & Co. July 20th.

21,827. "Locking device for electric lamp bulbs." H. H. Bailey and A. C. Pritchard. July 21st.

21,831. "Electric illuminating devices for theatrical stages, &c." T. H. Rochford. July 21st.

21,855. "Electro magnets." Soc. Anon. des Etablissements L. Bleriot. July 21st. (Belgium, July 31st, 1919.)

21,860. "Means for improving electrical contact between collectors and conducting rails, &c., of electric railways, &c." W. H. Lawes. July 21st.

21,863. "Variable inductance devices for tuning." J. Joseph and H. W. Sullivan. July 21st.

21,868. "Terminal receivers for electric wires." J. T. Callaway and S. A. Callaway. July 21st.

21,873. "Electric welding apparatus." British Thomson-Houston Co. (General Electric Co.). July 21st.

21,875. "Magneto-electric lamps." Philipps Akt.-Ges. July 21st. (Germany, July 24th, 1919.)

21,876. "Small magneto-electric machines." Philips Akt.-Ges. July 21st. (Germany, July 21st, 1919.)

21,899. "Electric switches." Igranic Electric Co. (Cutler-Hammer Manufacturing Co.). July 21st.

21,912. "Alternating current meter." Allgemeine Electricitats-Ges. July 21st. (Germany, July 22nd, 1919.)

21,914. "Wireless receiving apparatus." Metropolitan-Vickers Electrical Co. July 21st. (United States, August 5th, 1919.)

21,934. "Electrical junction, &c., boxes." H. Evans and St. Helens Cable and Rubber Co. July 22nd.

21,958. "Electric batteries." E. Alber. July 22nd. (Switzerland, July 26th, 1919.)

21,967. "Apparatus for heating water by electricity." R. G. Higham. July 22nd.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

11,562. "Energy-regulating arrangement for electric circuits." Siemens-Schuckertwerke. June 13th, 1917. (141,653.)

1919.

1,430. "System of control for maintaining the relative speeds of a number of electric motors." F. G. Warburton. January 20th, 1919. (147,243.)

5,764. "Manufacture of carbon electrodes." C. H. Thompson. March 8th, 1919. (147,247.)

7,179. "Electric cells or batteries." A. T. Austin and H. Adkins. September 22nd, 1919. (147,249.)

8,175. "Electric coin-operating bioscope." J. M. Davey and S. M. Green. April 1st, 1919. (147,250.)

8,292. "Sparking plugs." S. Fisher and W. Priddey. April 2nd, 1919. (147,251.)

8,619. "Thermionic valves." B. Hesketh. April 5th, 1919. (147,251.)

9,013. "Telephone cables." G. C. Pearson and Johnson & Phillips. April 9th, 1919. (147,264.)

9,443. "Electric signalling and indicating apparatus." McKenzie, Holland & Westinghouse Power Signal Co. and H. M. Proud. April 14th, 1919. (147,269.)

9,483. "Electrodes for electric welding." A. Le Chatelier. April 14th, 1919. (147,270.)

9,865. "Electric incandescent lamp and similar articles and methods of and apparatus for manufacturing the same." British Thomson-Houston Co. (General Electric Co.) April 17th, 1919. (147,293.)

10,048. "Electric switches." R. Norton. April 22nd, 1919. (147,302.)

11,780. "Electric fuses." H. R. Rivers-Moore, J. T. Burden and W. J. Hawes. May 10th, 1919. (147,316.)

13,135. "Electro-magnetic wave signalling systems." N. Lea and J. Ros. May 24th, 1919. (147,320.)

15,823. "Electro-deposition of metals." J. H. B. Jacombs. December 23rd, 1919. (147,338.)

18,321. "Thermostatic devices." Relay Automatic Telephone Co. and G. H. Bryant. July 23rd, 1919. (147,354.)

18,674. "Diaphragm for reception and reproduction of sound." E. M. C. Tigerstedt. July 26th, 1918. (130,600.)

22,126. "Sparking plugs." H. Longton. September 9th, 1919. (147,370.)

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